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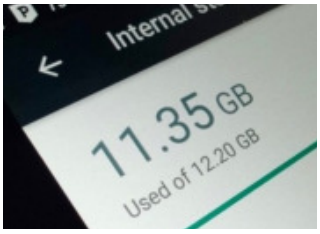
CONTENTS

PCWorld AUGUST 2020

» DEPARTMENTS

7 News

37 Reviews & Ratings



101 Here's How

118 Tech Spotlight

» FEATURES

83 Xbox Game Pass for PC: 5 reasons it's the best deal in PC gaming

90 Best PC games of 2020 (so far)

MASTHEAD

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Arm Macs and AMD rising: How Intel's endless 10nm struggles cost it so much

Tick-tock-bonk. **BY BRAD CHACOS**

Intel's endless 10nm nightmare has cost it so, so much.

It all started on September 5, 2014. That's the day Intel introduced 5th-gen Core M chips based on "Broadwell" (go.pcworld.com/5gcm), the company's first processors built using the 14-nanometer manufacturing process. Despite some manufacturing woes that pushed Broadwell back (go.pcworld.com/brbk) from its expected 2013 release, Intel's offering served as the vanguard of processor technology. AMD remained stuck on the 28nm process with its abysmal Bulldozer architecture. A mere month later, the Apple iPad Air 2 launched with a custom A8X chip that couldn't quite hang with Intel's older Haswell CPUs in Geekbench—but it was getting close

IMAGE: GORDON MAH UNG

(go.pcworld.com/gtcl).

Nearly six years later, the tables have turned. Intel's 10th-gen Core processors remain on an (upgraded) 14nm process. AMD's Ryzen chips have snatched the computing crown (go.pcworld.com/comc), and Apple's doing the unthinkable: switching Macs away from x86 CPUs onto its own custom Arm silicon. And if Apple's flight from Nvidia GPUs after "Bumpgate" (go.pcworld.com/flnv) in 2009 is any indication, it won't be coming back.

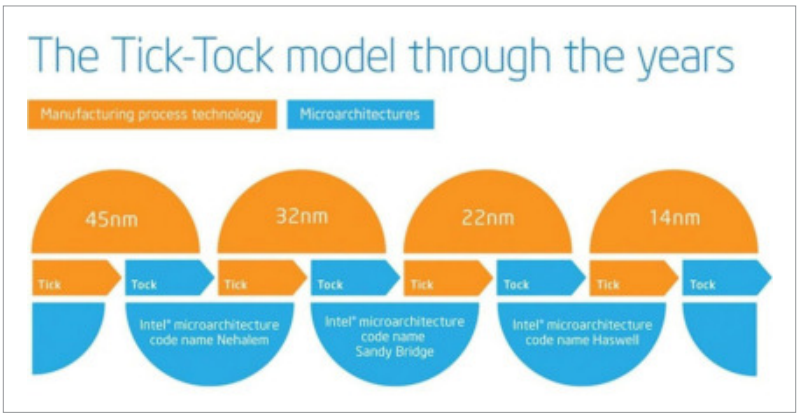
How did Intel get here? Let's look at how the company lost its way, starting with the death of tick-tock.

THE LONG ROAD TO 10NM

It wasn't supposed to be like this. Intel's original roadmaps expected 10nm chips to launch in 2016 (go.pcworld.com/16ln), with more advanced 7nm chips coming in 2018 (go.pcworld.com/18ln). Then the delays began.

The death of Intel's vaunted "tick-tock" manufacturing process served as the canary in the coal mine. For years, Intel's processors followed the tick-tock cadence, releasing upgraded CPUs with a smaller manufacturing process one generation, then a new microarchitecture built on the smaller process the following year. Tick-tock; tick-tock. The relentless innovation must have sounded like the doomsday clock to then-floundering AMD.

The troublesome 10nm process killed it. In early 2016, Intel confirmed that tick-tock was dead (go.pcworld.com/tkdd), adding a third leg to the process dubbed "optimization." Intel's 7th-gen "Kaby Lake" processors (go.pcworld.com/7grv) were flagged as the first "optimization" architecture in 2017, another 14nm chip following the releases of Broadwell and then Skylake. Considering that Intel still has yet to release 10nm desktop processors, it comes at no surprise that neither tick-tock nor tick-tock-optimization has been mentioned since.



Tick-tock's demise obviously delayed 10nm's arrival. Originally slated for a 2016 launch, by early that year Intel said (go.pcworld.

com/2h17) that its first 10nm would be "Cannon Lake" in the second half of 2017, a die-shrink of the optimized Kaby Lake architecture. It wouldn't launch until mid-2018 (go.pcworld.com/ln18), and only then in a handful of low-end systems with integrated graphics disabled. Later that year, we said "Cannon Lake is barely squeaked out in any reasonable volume." The release went so poorly that when Intel previewed 10nm "Sunny Cove" cores to the press in December 2018, it also vowed to decouple its architecture and IP from manufacturing process as much as possible to prevent stalls like this from happening again.

Intel desktop CPUs still game like champs.

Intel CEO Bob Swan blamed the delays on sheer ambition at Fortune's Brainstorm Tech Conference in mid-2019, citing the company's history of "defying odds." "At a time when it was getting harder and harder, we set a more and more aggressive goal. From that, it just took us longer…We prioritized performance at a time when predictability was really important," he said. "The short story is we learned from it and we'll get our 10nm node out this year. Our 7nm node will be out in two years and it will be a 2.0x scaling, so back to the historical Moore's Law curve."

Those 10nm Sunny Cove cores indeed hit laptops in the form of 10th-gen "Ice Lake" processors (go.pcworld.com/10ge) in August 2019. Yes, 10nm was finally, truly here—at least in notebooks. Intel's desktop offerings remain on the 14nm process. And even after the three-year delay, the actual 10nm CPU cores came with lower clock speeds (go.pcworld.com/lwsp) and didn't impress much.

Our performance analysis (go.pcworld.com/pfan) declared that Ice Lake's true appeal lay in its vastly upgraded graphics chops. "Our general takeaway is that the CPU is on a par with, or somewhat faster than, today's laptops in most conventional applications that don't touch the special sauce of improved encryption, AI or encoding features," we said. "In applications that touch those features, though, it's a major upgrade over existing 14nm chips." It's telling,

however, that Intel's "10th-gen" Comet Lake H gaming processors continue (go.pcworld.com/clke) to use the 14nm process and its higher clock speeds.

Intel hasn't sat still for half a decade; it's been fine-tuning the performance of its 14nm processors, introducing features like AVX-512 instructions, Thunderbolt 3, Wi-Fi 6, and greatly enhanced integrated graphics.

Intel's also been pushing what's possible with 14nm hard, to keep up with the competitive landscape. While the 14nm Core i7-6700K (go.pcworld.com/670k) debuted with four cores and 4.2 GHz Turbo speeds, the new 10-core, 20-thread Core i9-10900K (go.pcworld.com/190k) can hit up to 5.3GHz under optimal conditions. That might be why we haven't seen 10nm processors hit desktops yet. Intel's tuned the 14nm architectures so finely that it's hard to imagine newer 10nm coming anywhere close to the same raw speeds.

AMD's new 12-core Ryzen 9 3900X is the new king of mainstream performance CPUs.

AMD RISING

Intel's 10nm struggles have opened the doors for its rivals.

After the disastrous Bulldozer, AMD struck back big-time with its new Ryzen processors, built using TSMC's most advanced processing nodes. Ryzen debuted in 2017 (go.pcworld.com/db17) as a core-loaded 14nm monster that slaughtered Intel in multi-threaded tasks and overall value, but lagged in gaming performance. Lower prices and significant IPC improvements helped 2nd-gen Ryzen (go.pcworld.com/2ryz) supplant Intel's 8th-gen Core i7 as our recommended flagship processor. Then, with Intel mired at 14nm, AMD took the technological lead with 3rd-gen Ryzen CPUs (go.pcworld.com/3rzn) built using an advanced 7nm process with support for blazing-fast PCIe 4.0 storage. (Intel's latest 10th-gen chips remain on PCIe 3.0.)

"For probably 9 out of 10 consumers looking at a high-end CPU, they'll want to buy

the Ryzen 9 3900X [over the Core i9-9900K]," we declared in our review. Then AMD released the faster 16-core Ryzen 9 3950X (go.pcworld.com/x395) just to rub the victory in Intel's face. Check out our recap on how AMD's Ryzen snatched the computing crown from Intel (go.pcworld.com/ascn) after 15 long years if you want to learn more.

Ryzen processors dominate our list of the best CPUs, and AMD's taking full advantage. The company's gained market share for 10 straight quarters, hitting nearly 20 percent of total desktop pie (go.pcworld.com/20pc) for the first time since 2013. Ryzen desktop CPUs accounted for 86 percent of sales (go.pcworld.com/86pc) at Germany's enthusiast-focused Mindfactory this past February, and they've remained atop Amazon's CPU bestseller list (go.pcworld.com/blst) for years now. "In desktop, overall demand for our latest Ryzen 3000 and prior generation Ryzen 2000 processor families were strong, both of which continue to top retailer bestseller lists and have more than 50-percent share of premium processor sales at many top global etailers," CEO Lisa Su said to investors (go.pcworld.com/sdin) in April.

Making matters worse for Intel, 7nm Ryzen 4000 mobile chips (go.pcworld.com/40rz) introduced in 2020 enable performance that all but the highest-end Intel-based systems just can't match. "To put AMD's Ryzen 4000 in perspective, you have to understand that in AMD's 50-year history, it has never beaten Intel in laptops," we said in our review. "… AMD's Ryzen 4000 can spar with laptops that weigh two to even three times as much. This is something we frankly didn't expect. Ryzen 4000 is without a doubt the most game-changing performance laptop CPU we've seen in years."

Laptops remained a key bastion for Intel, but AMD's knocking. Notebooks like the Asus ROG Zephyrus G14 (go.pcworld.com/zp14), Acer Swift 3 (go.pcworld.com/asf3), and the Dell G5 15 SE (go.pcworld.com/se15) deliver killer performance at killer prices. AMD expects over 100 laptops with Ryzen 4000 to launch in 2020. It also expects to release next-gen

Screenshot of Amazon's best-selling desktop CPUs on June 23, 2020.

The Asus ROG Zephyrus G14 was the first laptop out of the gate with AMD's Ryzen 9 4900HS mobile CPU, revealed March 30, 2020.

Ryzen desktop processors later this year, further driving home its technological advantage.

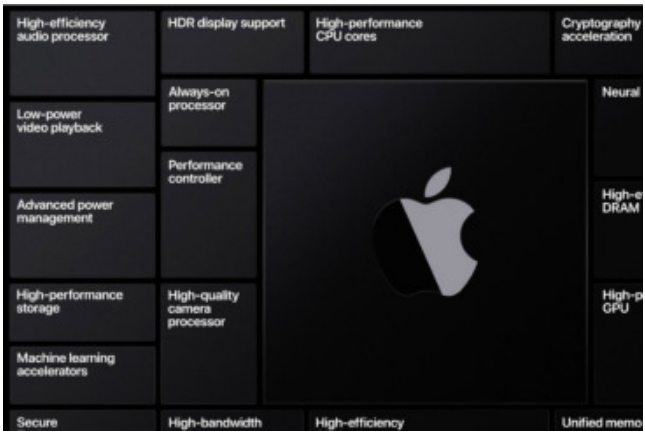
ARM MACS

And now, a long-anticipated, yet still-wild shoe has dropped: Apple is dumping Intel's x86 processors in Macs (go.pcworld.com/ix86), shifting to its homegrown A-series Arm chips instead.

Apple historically has little patience with partners that fail to meet expectations. The company's leadership can't be happy that Intel's processors have largely stalled in performance upgrades over the last half-decade.

During that time, Apple's own hardware team has kept the pedal to the medal. Ars Technica's testing (go.pcworld.com/a12z) shows that the A12Z Bionic inside the new iPad Pro delivers GeekBench scores higher than the Core i5 inside the 2020 MacBook in both single-core and multi-core tests. It actually comes closer to the Core i9 inside the 2019 MacBook Pro in single-thread performance despite the iPad Pro's tighter thermal constraints.

GeekBench is just a single benchmark, and usurping the Intel Xeon chips inside the



Apple teasing some of the capabilities coming in its Arm processors for future Macs.

higher-end MacBook Pros will be a difficult challenge. Still, Apple obviously feels its future is more secure in its own hands rather than Intel's. The transition from Intel to ARM will be painful (go.pcworld.com/pnfl) for Mac users, but it should be fun to see what Apple's engineers can whip up now that the chains are off.

The Acer Swift 5 is the first laptop announced with Intel's next-gen "Tiger Lake" CPU and upgraded Xe graphics.

Either way, it's yet another in a series of body blows for Intel. NetMarketShare (go.pcworld.com/nemk) puts MacOS at about 10 percent of the total PC market, and analyst firms place quarterly sales for Macs in roughly the same ballpark. Losing 10 percent of the valuable laptop market hurts, especially when you consider that AMD's hoovering up more customers in the desktop and server markets, and making serious inroads on laptop integrations too. All those small losses start to feel mighty big when you add them together.

The day after Apple announced its move, Acer teased the world's first laptop with Intel's 10nm+ Tiger Lake chip and Xe graphics (go.pcworld.com/tglk). Don't think it's a coincidence. Intel's making bank right now (go.pcworld.com/mbnk), but it's in a fight for the future, pummeled left and right by Apple and a resurgent AMD. Tiger Lake needs to impress, or at least hold the line as much as possible.

Intel's endless 10nm nightmare has cost it so, so much—but Chipzilla's fought back from behind before. After AMD stunned the world by beating Intel with Athlon 64 nearly 15 long years ago, Intel responded with the stunningly successful Core architecture that heralded over a decade of unrivaled dominance. It could happen again, but the odds of success seem far less likely this time around. AMD's firing on all cylinders, and Apple's not coming back. After a half-decade of stagnation, Intel has a fierce fight on its hands.

Intel says it will start manufacturing advanced 7nm chips in 2021 (go.pcworld.com/7n21). The company still hasn't announced any 10nm Core chips for the desktop. We'll see how it goes.

Closing Microsoft Stores means more support and buying headaches for Windows users

Can Microsoft rise to the challenge and revamp its online Microsoft Store presence as dramatically as it did for Microsoft Build? **BY MARK HACHMAN**

Apple Macs "just work" (for now, at least (go.pcworld.com/tr20). PCs are hobbyist machines. Both are stereotypes, sure, but they might offer some explanation why Apple Stores are thriving and Microsoft just decided to close all of its stores (go.pcworld.com/clos).

Microsoft spun (go.pcworld.com/5pun) the closure into a "new approach to retail," one that would be driven through its website and online sales channels, rather than through a network of physical stores. (Amazon must be chuckling at this.) But the writing was on the wall: In 2019, Microsoft shuttered virtually

IMAGE: MARTYN WILLIAMS

all of its retail kiosks at malls and other shopping centers, leaving the larger Microsoft Stores on uncertain ground.

If you walked into a mall the last few years, the evidence was there in front of you: shoppers visited Apple Stores, and generally ignored Microsoft Stores. That's a little odd, when you think about it. A 2018 analysis by Thinknum (go.pcworld.com/thnm) shows that Microsoft Stores tended to open in the shadow of Apple Stores, so that technology buyers would have options from which to choose. So why did Microsoft Stores fail?

Part of it might have just been their respective approaches to retail. Microsoft Stores always felt a bit like a coffee shop: a place to hang out and talk technology in general. Apple Stores always felt more like an exclusive restaurant: If you're not here to buy something, get out. You browsed at Microsoft Stores. You visited Apple Stores. The pandemic, of course, had its own, profound effects on both.

MICROSOFT STORES OFFERED PC SUPPORT, TOO

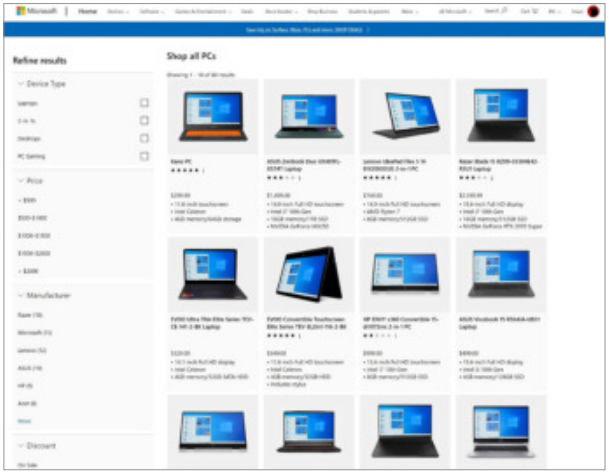
But viewing Apple Stores and Microsoft Stores alike as only stores also missed their secondary purpose: as a support hub. As anyone who's owned an iPhone knows, if something goes wrong, your first stop is usually an Apple Store and its Genius Bar technicians. It's impossible to know how many people visit an Apple Store just to browse versus scheduling a repair appointment. But I'd bet the proportions swung more toward the service side than in the Windows world. (We asked Microsoft for comment, but they haven't responded.)

Closing Microsoft's physical stores will certainly hurt. I visited Microsoft's San Francisco store on multiple occasions on the way back from work—sometimes to see if I could take advantage of a holiday promotion, or to see how consumers were reacting to a new Surface product, or occasionally to seek out support myself. Microsoft's own Surface products certainly aren't worry-free. Microsoft's Surface Book 2 had numerous bugs, and I've brought our review unit in for servicing before. One of our overheating 15-inch models apparently had a discrete GPU whose thermal paste failed over time, which we worked out at the support counter.

I think it's fair, however, to say that consumers expect their Apple products to work. When they don't, something is wrong, and an Apple tech is required to fix it. When a typical PC user encounters a bug, they sigh, swear, and start hunting down solutions. PC buyers tend to understand that a $599 PC will ship with a few blemishes. Apple wants you to bring its products in for servicing, like a luxury automobile. A Windows PCs can be tweaked by any shadetree mechanic.

We'll likely see this trend continue. With the pandemic still raging, there's less emphasis on browsing physical stores.

Instead, people still mostly shop online, and simply return items with physical flaws or that they can't fix themselves. As customers learn more about their PC, they're turning to community support sites like Reddit, how-to videos, and other DIY fixes. Microsoft could also turn toward a strategy it's pursued in the past (go.pcworld.com/purs): establishing "store-within-a-store" outposts at retailers like Best Buy.



Going forward, this will be the "Microsoft Store." Can Microsoft revamp it into something transformative?

What Microsoft Stores offered was a trusted, neutral brand for showcasing the PC as a whole, and providing service when necessary. That now goes away. Microsoft conspiracy theorists will see this as another example of Microsoft's march away from the consumer, and there's some truth to that, though Windows and Xbox get plenty of attention at major retailers like Best Buy, Walmart, and Target. And it's undoubtedly a little weird that while Microsoft has closed its physical stores, AT&T, Apple, T-Mobile, and Verizon stores still exist.

I'd like to think, though, that Microsoft now has an unprecedented opportunity to overhaul sales and support in much the same way it reinvented the online conference. This year's Microsoft Build was a superb example of how to provide on-demand sessions across multiple time zones, together with focused "labs" sessions where developers could ask questions. With Microsoft Stores closed, where does Microsoft go from here?

Can Microsoft take advantage of consumer smartphones to diagnose problems? Can it use remote-access technologies to do the same? Does it invest in local computer repair shops as authorized service dealers? Can the online Microsoft Store do for online sales what the Surface did for PCs: use 360-degree GIFs or even short, neutral hands-on videos to provide a more comprehensive look at the product?

For the short term, closing the Microsoft Stores just accelerates the trend of the DIY PC enthusiast. The challenge now for Microsoft is to take its move away from brick-and-mortar stores and find an opportunity online.

Microsoft Teams adds 'Together mode' in massive update

Microsoft is driving hard to make Microsoft Teams the new Zoom. **BY MARK HACHMAN**

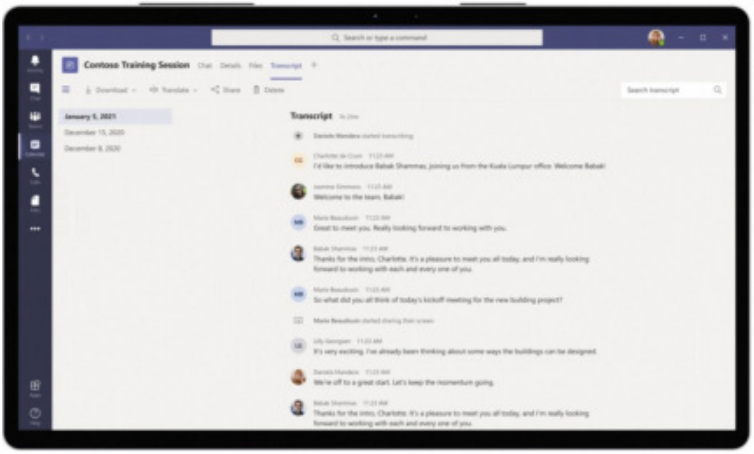
Microsoft today said that it's shaking up online Teams video meetings with a new Together mode that places participants in a virtual auditorium. It's all part of a redesigned Teams experience that capitalizes on some of the promises Microsoft has been making for years. There's even a pair of Teams smart displays.

Microsoft said the company has spent much of the last few months rethinking the way in which video meetings were conducted. About 60 percent of those surveyed said they felt less connected to their colleagues due to the coronavirus, so Microsoft's new Teams update tries to make nonverbal communication a priority.

Several features play into this aspect of the Teams revamp, including chat bubbles, an updated way to "raise your hand" during

IMAGE: MICROSOFT

meetings, and even live reactions. An earlier version of the "raise hand" option simply popped up a small hand icon. Now Teams will outline that particular speaker window in yellow, as an unobtrusive signal that the participant wishes to contribute.



Here's what a post-meeting transcript within Microsoft Teams will look like.

Live transcription within Teams.

TEXT IS A PRIORITY IN TEAMS' VIDEO CALLS

However, you don't have to participate in the conversation orally. The chat window in Teams (and competing services) has become a sort of side channel to carry on the conversation without interrupting the presenter. Here, Teams is introducing something new: chat bubbles, with small snippets of text that will appear over your head if you want to chime in with a supportive comment or question. If that's too distracting, Microsoft has stolen a page from other chat apps, and added "live reactions," Microsoft's name for emoji (like a heart) that participants can trigger and that can bubble up from their window.

The new dynamic mode within Microsoft Teams.

Microsoft has also said for a while now that transcription and translation are a key part of the collaborative office experience (go.pcworld.com/colb), from showing off automatic translation in Skype (go.pcworld.com/skpe) to its vision of the office of the future, where a conversation is translated in real time. Speaker attribution, where Teams automatically highlights the speaker, will arrive "soon," Microsoft said.

Microsoft promised that live transcripts will arrive later this year, together with a searchable transcript file that will be attached to the meeting.

Real-time transcriptions will follow soon after that, Microsoft said. (The company made clear, however, that it will not be able to pick out individual speakers from a group that's joining a Teams chat from, say, a conference room.)

MAKING TEAMS VIDEO LOOK BETTER WITH TOGETHER MODE AND MORE

Microsoft was late to the game with AI backgrounds, and it's now trying to recapture the conversation. Teams will begin adding video filters to adjust lighting levels algorithmically and create other effects, enhancing the way you look on camera. Teams is adding a dynamic view, which will adjust the size of the video windows that show participants, but also allow you to "pin"

key speakers, so their windows will never be accidentally minimalized.

Teams meetings will grow to 1,000 participants, though you'll never see all of those windows onscreen at one time—49 simultaneous video windows are supported, and that hasn't changed. (Up to 20,000 people can passively watch a Teams presentation, Microsoft said.)

A "coffee shop" view appears to be one of the upcoming alternatives within Teams' Together mode.

In a way, Together mode combines all of that. Instead of placing participants in their own video windows, Microsoft uses AI to "snip" participants out of their backgrounds and place them in a virtual auditorium. The result may appear a bit surreal—these are literal talking heads, after all—but it's a way to fit more virtual participants onscreen at one time.

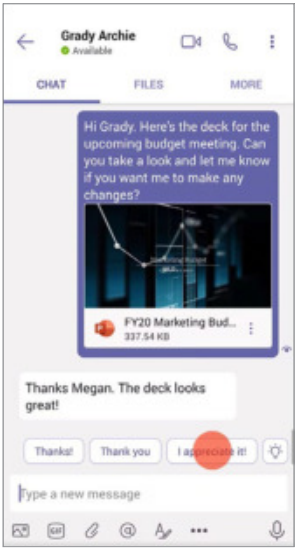
Microsoft said it has also used gaze tracking to try and orient the resulting images so they appear to be looking straight at you, even if their camera setup is slightly offset. Together mode will roll out in August, Microsoft said, and new backdrops will be added over time.

MOBILE TEAMS ADDS CORTANA

Microsoft is also beefing up the Teams mobile experience. Javier Soltero, formerly responsible for Cortana's development, told *PCWorld* in 2018 (go.pcworld.com/crtd) that Cortana's intelligence would be distributed across various apps. Soltero left Microsoft to run Google's G Suite, but Microsoft's corporate vice president of Microsoft 365, Jared Spataro, has brought Cortana within Teams.

Within the coming weeks, Microsoft said, Teams users on Android and iOS (and who subscribe to Microsoft 365) will be able to ask Cortana to make a call, send files and author chat messages, and more.

Microsoft is adding the "suggested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replies" that have become common in Google's Gmail and Microsoft Outlook, where you'll be able to tap a quick bubble with a "Will do!" or "Can we talk about this?" in response to the content of a previous message. Teams will add an internal Tasks app, which pulls together similar features from Outlook and Microsoft To-Do, providing a unified dashboard within Teams of things you need to get done. This sort of cross-pollination of functions began with Outlook (including Mail and Calendar tabs within the mobile app), and the same thinking is moving to Teams.

NEW TEAMS HARDWARE ON THE HORIZON

Finally, Microsoft said that the Microsoft Teams hardware that was announced earlier this year will be deployed later this year. Microsoft's statement was a little odd, given that the Lenovo ThinkSmart View (go.pcworld.com/thsm), a $350 device that Lenovo announced at CES in January, is already available and shipping.

The ThinkSmart View is a "companion" device that works alongside a laptop, connecting (exclusively) to Teams and providing a 5MP front-facing camera and a 1200x800 8-inch IPS screen for conducting video calls. Presumably, a second companion device from Yealink that will debut later this year will have similar features.

Finally, Microsoft said that Teams capabilities will be added to the Surface Hub, complete with a new room remote feature that will go live later this year within the Teams mobile app. Users will be able to use the app to launch features via voice commands.

Lenovo's ThinkSmart View, one of a new breed of affordable Teams hardware.

Powerful new Qualcomm Snapdragon 865 Plus headed for gaming phones

Lenovo's first Legion gaming phone and the Asus ROG Phone 3 will ship with Snapdragon 865 Plus inside. **BY MARK HACHMAN**

Recently, Qualcomm unveiled the Snapdragon 865 Plus 5G platform, confirming previous rumors while offering faster CPU and GPU clock speeds, upgraded Wi-Fi, plus 5G modem support.

The Qualcomm Snapdragon 865 Plus 5G platform (also referred to as the Snapdragon 865 Plus, when speaking about the chip itself) is essentially an upgraded version of the Snapdragon 865 chip (go.pcworld.com/sn86) the company unveiled last December for premium smartphones. The Snapdragon 865 introduced a host of new features,

IMAGE: QUALCOMM

including (go.pcworld.com/in86) camera upgrades, AI, security, and gaming. The Snapdragon 865 was designed around Qualcomm's standalone X55 5G modem, and the Snapdragon 865 Plus is as well, though neither is integrated. Both the 865 and the 865 Plus are 7nm chips.

Almost all of the features on both the Snapdragon 865 and 865 Plus are common to both platforms. The Kryo 585 CPU, the Adreno 650 GPU, the Hexagon 698 DSP and the Spectra 480 image signal processing remain in place. Qualcomm left the associated memory unchanged.

What's different are the clock speeds and subsequent performance improvements. The Kryo 585 in the Snapdragon 865 Plus is now clocked at 3.1GHz, versus 2.84GHz, a 10-percent performance increase, Qualcomm said. Qualcomm didn't release the speed of the Adreno 650, but the company said performance increased by 10 percent there, too.

Gaming appears to be a key focus for the Snapdragon 865 Plus, as it was for the Snapdragon 765G in the prior generation. That chip bumped up the clock speed (compared to the regular Snapdragon 765) to attract mobile gamers, and it added a Snapdragon Elite Gaming package, whose features included PC-like graphics effects and downloadable driver updates. All of those Elite Gaming features are included with the Snapdragon 865 Plus, too.

Broadcom may have been the first to ship a Wi-Fi 6E chip (go.pcworld.com/6ech) for mobile devices, but Wi-Fi 6E represents the other major upgrade to the Snapdragon 865 Plus 5G. Now that the FCC has opened up additional channels for Wi-Fi, Qualcomm's new FastConnect 6900 can tap into the new 6GHz spectral band and 160GHz channels. In the real world, that means gobs more bandwidth, provided there's a Wi-Fi 6E router feeding the beast. It all translates into 3.6Gbps peak throughput, versus

Qualcomm's Snapdragon Elite Gaming represents the company's foray into mobile gaming…

...with PC-like features such as support for adaptive-rate displays.

1.774Gbps with the Snapdragon 865's FastConnect 6800 subsystem.

What hasn't changed is Qualcomm's insistence that phone makers bundle the X55 5G modem as part of the Snapdragon 865 Plus 5G chipset. Phone journalists spent much of 2019 jetting to odd locales and testing the bandwidth of 5G's mmWave and sub-6GHz modes, as carriers slowly ramped up their coverage areas and solidified their messaging.

The current pandemic has likely slowed down demand as most people stick closer to home. As regions of the world phase back to some level of normal activity, travelers will thirst again for wide, deep channels of data flowing back and forth from their phones. It's also true, however, that adding a 5G modem will tack on some additional cost to phones at a time when economies worldwide are reeling from the pandemic's effects.

Still, Qualcomm says more than 140 devices have been designed around the Snapdragon 865, or are in the works. We already have a couple of Snapdragon 865 Plus 5G phones waiting in the wings: Asus has preannounced the ROG Phone 3, and Lenovo's extending its Legion gaming brand to phones. These phones will begin shipping in the third quarter, Qualcomm said. All in all, if you're looking for a fast Android phone for gaming, chances are that the Snapdragon 865 Plus 5G will be inside.

Belkin Thunderbolt Dock Core is first dual-powered Thunderbolt dock

Thunderbolt docks are on the rise. **BY MARK HACHMAN**

In late June, Belkin launched the Thunderbolt Dock Core, which the company claims is the first Thunderbolt-certified dual-powered Thunderbolt 3 dock.

The $170 Thunderbolt Dock Core accepts your laptop's power supply (assuming it charges via USB-C), which can plug into the USB-C (PD) port on the side of Belkin's dock. The port then supplies up to 60W to the

IMAGE: BELKIN

laptop, which is typically enough to power an ultralight laptop or similar model. Because the device is dual-powered, the opposite is also true: The dock can pull its own power directly from the laptop's Thunderbolt cable if needed.

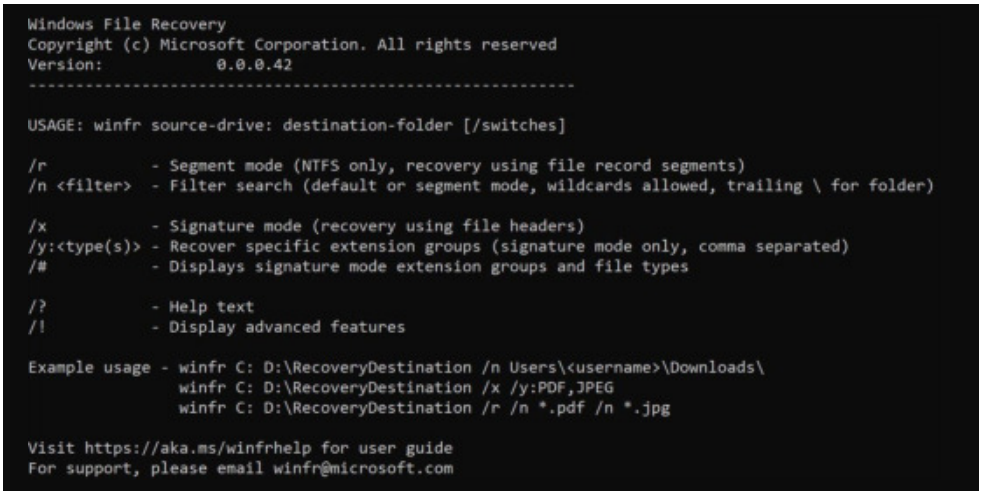
What's the difference between a USB-C hub (go.pcworld.com/uchb) and a Thunderbolt dock? They use the same physical interface—a Thunderbolt port can sometimes be indicated by a small lightning bolt, though your laptop's manual is sometimes the best indicator. Data throughput is the difference, along with the ability to connect multiple high-definition displays at once.

In any case, the difference is fairly stark: A USB-C hub can power an external 4K monitor at an eye-straining 30Hz, but a Thunderbolt 3 dock has enough typical bandwidth to power a pair of 4K displays at a more comfortable 60Hz refresh rate. According to Maggie Curran, the vice president of channel for Belkin, the demand for dual displays has "exploded" as more and more people work from home.

Like a USB-C hub, however, you can typically mix and match ports and other I/O connections. Here, Belkin's Dock Core offers the basics: one HDMI 2.0 port and a DisplayPort 1.4 port, plus a USB-A 3.2 Gen 2(10Gbps) and a USB-A 2.0 port. Other docks, such as the $139.99 Belkin Thunderbolt 3 Dock Mini HD (go.pcworld.com/mnhd), use a pair of HDMI ports instead.

Belkin typically engages with businesses, where long-term relationships can be crucial. USB-C hubs and some docks have an unfortunate habit of being replaced or phased out quickly; Curran said that Belkin typically provides a two- to even five-year warranty to provide product stability. (The Dock Core has a two-year warranty attached.)

The Thunderbolt 3 Dock Core will be available for purchase July 2020 at Belkin.com (go.pcworld.com/t3dc), Amazon.com and CDW.com (go.pcworld.com/cdwc), according to Belkin.


Windows File Recovery
Copyright (c) Microsoft Corporation. All rights reserved
Version: 0.0.0.42
USAGE: winfr source-drive: destination-folder [/switches]
/r - Segment mode (NTFS only, recovery using file record segments)
/n <filter> - Filter search (default or segment mode, wildcards allowed, trailing \ for folder)
/x - Signature mode (recovery using file headers)
/y:<type(s)> - Recover specific extension groups (signature mode only, comma separated)
/# - Displays signature mode extension groups and file types
/? - Help text
/! - Display advanced features
Example usage - winfr C: D:\RecoveryDestination /n Users\<username>\Downloads\
winfr C: D:\RecoveryDestination /x /y:PDF,JPEG
winfr C: D:\RecoveryDestination /r /n *.pdf /n *.jpg
Visit https://aka.ms/winfrhelp for user guide
For support, please email winfr@microsoft.com

Windows File Recovery is Windows' new tool for finding lost files

Mind your syntax: you'll need to be exact to make this utility work. **BY MARK HACHMAN**

Accidentally deleting a file can be a nightmare. A new Windows 10 recovery tool, Windows File Recovery, can help—though it's geared towards those who don't mind using a command-line interface.

Windows File Recovery (go.pcworld.com/wnfr), a free Microsoft app now on the Windows Store, offers a way to restore files that have become accidentally deleted. It does require Windows 10 build 19041 or higher, however, and also doesn't work on a file that's been stored to the cloud. You'll also need two separate drives, which can be as simple as a USB drive if you're trying to recover a file from the boot disk.

The app is essentially a command-line interface disguised as an app, so recovering a file is a strictly text-based affair. Microsoft automatically creates a recovery folder for you called Recovery_<*date and time*> on the destination drive. The basis interface looks like this:

winfr source-drive: destination-drive: [/switches]

Microsoft provides some additional examples. For example, here's how to recover JPEG and PNG photos from your Pictures

IMAGE: MICROSOFT

folder to the recovery folder on an E: drive.

```
winfr C: E: /n \Users\\Pictures\*.JPEG /n \Users\\Pictures\*.PNG
```

Those examples use what Microsoft calls the Default mode for the Windows File Recovery interface. There are two others: Segment mode and Signature mode. Default mode uses the Master File Table (MFT) to locate lost files. (The MFT stores the information required to retrieve files from an NTFS partition.) If the MFT is missing or corrupted, you can use Segment mode, which requires segments: summaries of file information that NTFS stores in the MFT such as name, date, size, type and the cluster/allocation unit index. Signature mode searches for file types, such as PDF or PNG files. If you're searching an external drive, only Signature mode can be used, Microsoft says.

If you've lost a file, Microsoft specifically recommends not using your PC until the

Windows File Recovery lets you restore files that have become accidentally deleted

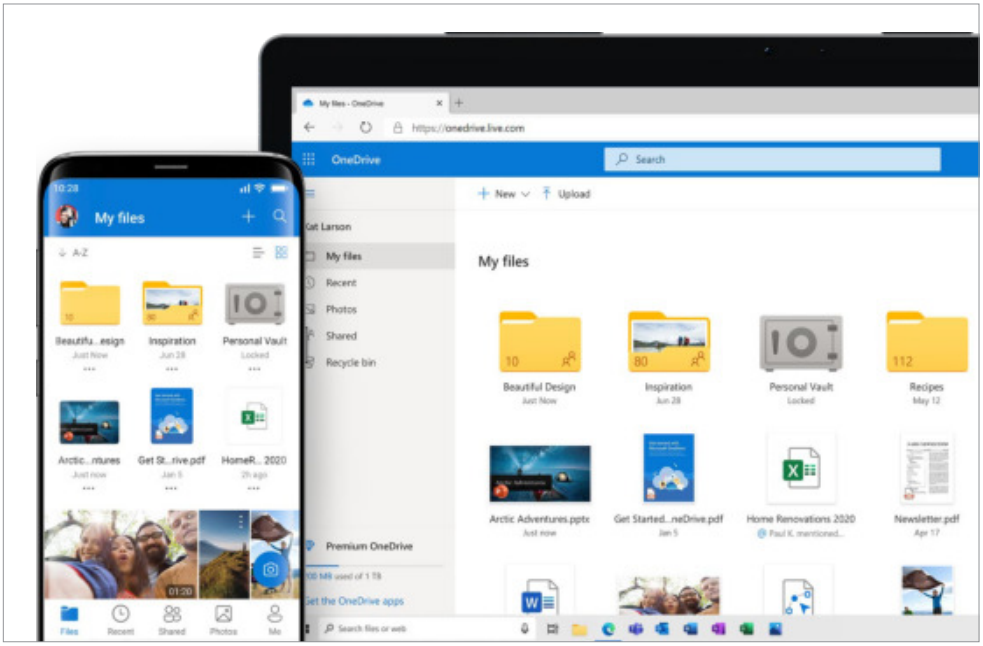
Windows File Recovery utility can be run. "In the Windows file system, the space used by a deleted file is marked as free space, which means the file data can still exist and be recovered. But any use of your computer can create files, which may over-write this free space at any time," Microsoft said in a list of frequently asked questions (go.pcworld.com/freq) about the MFR app.

```
Windows File Recovery
Copyright (c) Microsoft Corporation. All rights reserved
Version:            0.0.0.42
------------------------------------------------------------

USAGE: winfr source-drive: destination-folder [/switches]
/p:<folder>     - Specify recovery log destination (default: destination folder)
/a              - Accepts all user prompts

/u              - Recover non-deleted files (default/segment mode only)
/k              - Recover system files (default/segment mode only)
/o:<a|n|b>      - Overwrite (a)lways, (n)ever or keep (b)oth always (default/segment mode only)
/g              - Recover files without primary data stream (default: false, default/segment mode only)
/e              - Disable extension exclusion list (default/segment mode only)
/e:<extension>  - Disable specific extension(s) (default extension list no longer applies) (default/segment mode only)

/s:<sectors>    - Number of sectors in volume (segment/signature mode only)
/b:<bytes>      - Number of bytes in cluster (segment/signature mode only)
/f:<sector>     - First sector to scan (segment/signature mode only)
```

Recovering a file is a strictly text-based affair.

OneDrive simplifies document sharing by making it more complex

Microsoft has somehow managed to take what you might think to be a fairly simple process—sharing a document—and Microsoft-ed it. **BY MARK HACHMAN**



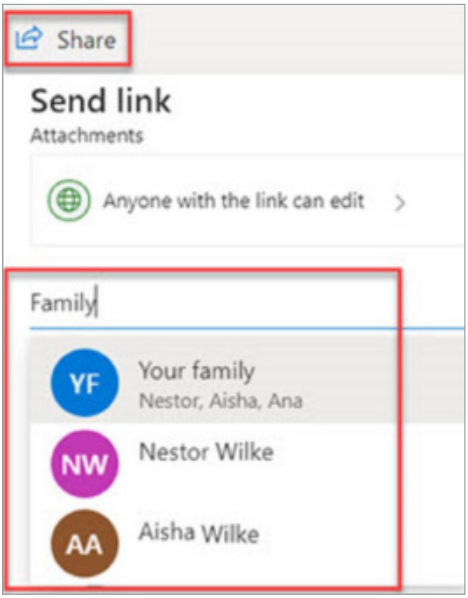
Microsoft said in early July that it's making OneDrive file sharing more manageable, adding a convenient way to share folders and files with friends, while giving business users more control over a file as it moves through an organization.

"Sharing" a file or folder seems simple, but it's really not—not when you (or your company) needs to decide who has access, and what happens when things move locations. Negotiating all of those requirements is the foundation for the OneDrive changes Microsoft announced recently.

NEW ONEDRIVE CONSUMER CONTROLS

Microsoft already allows you to right-click a file within OneDrive for the web and share it with

IMAGE: MICROSOFT



After you've created your groups of family members or friends, you'll be able to share files with them easily.

specific contacts, with permissions that include edit controls, passwords, and the like. What Microsoft calls "family and group sharing" will arrive on OneDrive for the web later this month, with general availability coming in July. Essentially, Microsoft seems to think that configuring each folder or file is too time-consuming, so it's allowing you to predefine a "family" group or circle of friends beforehand.

That sounds easy, but setting it up is complex. You'll first need to define a family group of individuals with Microsoft accounts, just like you can do to limit your kids' screen time within Windows or the Xbox (go.pcworld.com/lmxb). Creating a group of friends (go.pcworld.com/gpfr) is even more of a pain, requiring you to go into Outlook.com. After all that, you'll have predefined groups with which you can share files and folders on the web.

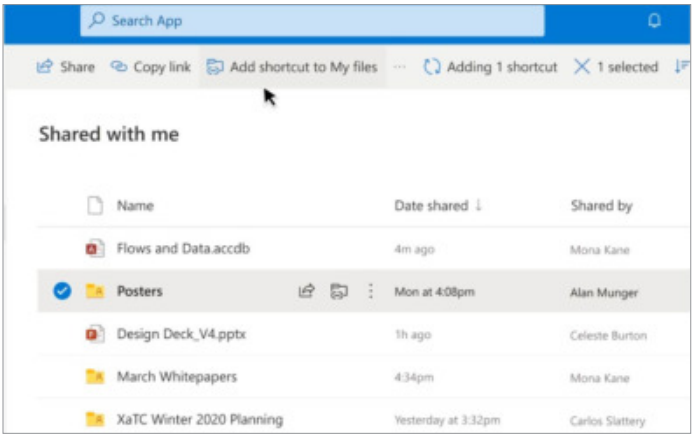
Granted, Microsoft's new consumer controls assume a world where photos and videos aren't already shared by text messaging apps or social media. It's also not universal yet: the feature will be added to the OneDrive mobile app, sync client, Mac, and directly from Word, Excel, and PowerPoint by the end of this year.

Companion to this announcement, Microsoft is increasing the size of uploads from 20GB to 100GB, as well as adding dark mode to OneDrive for the web.

ONEDRIVE ADDS LOCAL COPIES OF SHARED DOCUMENTS

OneDrive for enterprise is constantly negotiating a fine line between sharing documents in the spirit of collaboration, and preventing them from being "shared" to competitors outside corporate walls.

A new feature called Add To OneDrive straddles that line. Like Microsoft's new consumer controls for OneDrive, Add To OneDrive takes an existing feature and broadens it. Within OneDrive for the web, there's already a Shared With Me heading that lists files that others have shared with you.



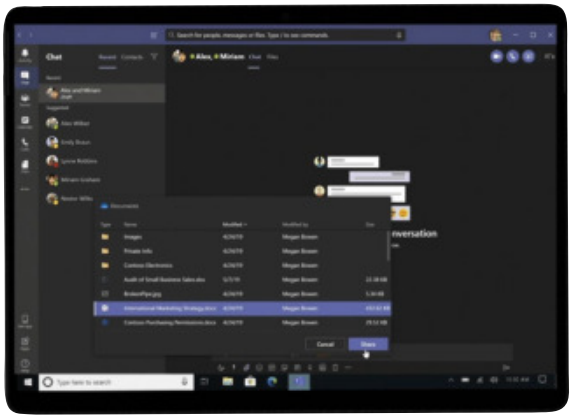
Add To OneDrive allows you to keep your own links to shared files.

(The Office app for Windows does the same.) Add To OneDrive lets you to take a file under the Shared With Me heading and create a shortcut to it within your own list of OneDrive files. It doesn't change anything else about the file, though, leaving all of its permissions in place.

Those permissions become even more important as a file moves through a development process. Take a planning document: While it may exist as a file shared between a small workgroup of employees, eventually it may evolve into a document a legal team and senior management may want to review.

Later this summer, the permissions of the file, as it's moved from a OneDrive folder with one group of participants to another folder with a *different* group of participants, will be automatically reconfigured, so that both groups will have access to the same file. If necessary, OneDrive will send out new file links—which sounds like a pain for users to track, honestly.

Microsoft said it's working to extend OneDrive's file sharing and access control to Teams, so that you'll be able to assign files and permissions without leaving the app. Conversely, Microsoft said it will allow users to turn off notifications on new files beginning later this year, to minimize distraction. Users will also be able to share files as a URL, rather than require the actual filename be use.



You'll be able to share OneDrive files more easily with Teams.

The Oculus Go is dead, and virtual reality is better for it

The death of the entry-level Oculus Go headset in June was as unexpected as it was overdue.

BY HAYDEN DINGMAN

Oculus stopped selling its entry-level virtual reality headset, the Oculus Go, in June. Usually this kind of announcement would be met with nostalgic retrospectives and beers poured on the floor. Much lamenting, and all that. Even the worst products usually get a rose-colored sendoff.

But virtual reality is better off without Go around, and so is Oculus.

THE GEAR VR ERA

You'll get no eulogy from me. Not a fond one, anyway. The Oculus Go was a play for the mass market that completely misunderstood the mass market. Staring down the barrel of the $600 Oculus Rift, the goal was to get people into virtual reality as cheaply as possible. Break down the barriers. Build the ecosystem.

That process began with the Samsung

IMAGE: FACEBOOK

Gear VR. Using an existing Samsung phone to power a VR experience seemed novel circa 2015, when Gear VR debuted. There were no consumer-facing VR headsets at that point. The Rift and Vive were still a year out, and it was exciting to have a *real product* in hand—and for cheap, if you already owned a Samsung phone. $100 for VR? Not a bad deal.

And it's worth remembering that Gear VR didn't seem so limited in those days. It didn't have hand-tracking—but then, neither did the Oculus Rift at the time. *Titans of Space*, *Dreadhalls*, *Esper 2*, *Keep Talking* and *Nobody Explodes*, all the best of the early Rift games came over to Gear VR in some form because the platforms were fundamentally the same.

Then room-scale VR came along. Five years later it already seems like ancient history, but there was a time when Oculus didn't believe in room scale. There was a time when every Oculus demo took place seated with an Xbox controller in-hand. The now-essential Oculus Touch controllers shipped nine months after the Rift, as Oculus retrofitted its tracking system to catch up with Valve and the HTC Vive.

Virtual reality changed. Not overnight, maybe, but it changed. I can't remember the last time I played a major VR release sitting down with an Xbox controller. And yet that was still the experience offered first by Gear VR and then later by Oculus Go.

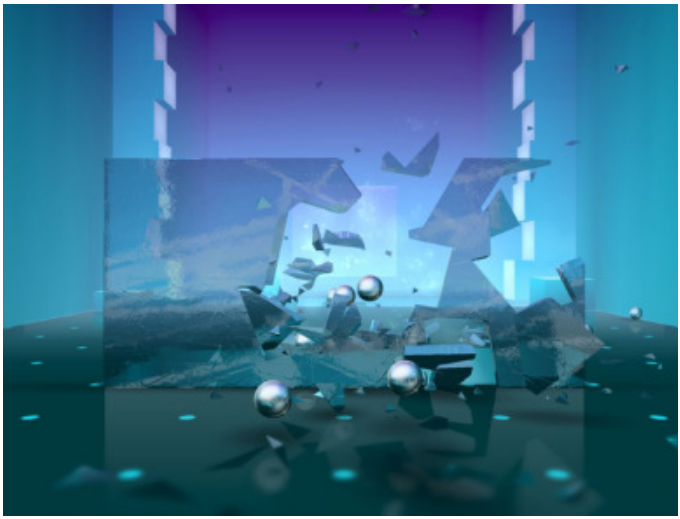
GOING NOWHERE

Released in 2018, Go basically repackaged the Gear VR concept without the need for a separate phone purchase. Not a terrible idea, perhaps. At $200, Oculus Go seemed downright affordable next to 2018's Rift and Vive prices. And if all you wanted was to watch 360-degree videos? Sure, Go worked.

As I said, it was a play for the mass market. A play for Facebook's "social VR," perhaps. If your goal is to sell a billion VR headsets… well, you're not going to do that by selling to people who play video games. Even the best-selling consoles top out around 100 million units. The (seemingly obvious) solution: Make an affordable headset that appeals to a different audience.

But as it turns out, it's hard to sell people on virtual reality if you strip out everything that

makes virtual reality special. Even by 2018 standards, Oculus Go provided a dismal experience. Seated, with a lackluster display and a mediocre battery, Go's only strength was its lack of cabling. Like Gear VR, that made it *great* for demoing to first-timers (go.pcworld.com/1dmo). You could take Go anywhere, and a hell of a lot easier than you could drag your Rift to a friend's place.



***Smash Hit* is one of the Oculus Go's most popular games.**

Buy one, though? That was harder to recommend. Rift games no longer made it over to Oculus Go. There was no Lone Echo on Go, nor even the potential for it. The platforms were fundamentally different. Look at the Top Selling Oculus Go games (go.pcworld.com/tpgm), and it's remarkable how many of them are still games released for Gear VR in 2015. The Rift struggled for years to produce a solid software lineup even with enthusiastic developers behind it. Oculus Go never had a chance.

Besides, Oculus Go didn't *feel* like a gaming device. As I said, this wasn't aimed at the same people as the Rift and Vive. Maybe you'd play *Angry Birds* or *Thumper*, but Go was primed for media consumption. Ostensibly that meant viewing 360-degree videos of the Grand Canyon and the White House and such. Realistically, I'm guessing a lot of people used the Go for **ahem** adult viewing.

Virtual vices aside, there simply wasn't much to do with Oculus Go. It had no room for growth, no real potential. It was a snapshot of VR circa 2015, frozen in time.

And it muddied the waters. Trying to convey to potential buyers that no, the Oculus Go experience was nothing like the full Rift/Vive experience? That no, the hype they'd heard didn't apply to Go? That was tricky. People bought Go thinking they'd finally "get into" VR, just as Facebook and Oculus intended—but Go gave them little reason to explore or be excited about the platform.

It was a dead end.

THE RIGHTFUL HEIR

Just a year later Oculus Quest (go.pcworld.com/ocqs) released, and Go's death was all but inevitable. At $400, Quest wasn't "entry-level" like Go—but it replicated the full room-scale desktop experience. It had hand-tracking. It had top-tier Rift games like *Beat Saber* and *Tilt Brush* and *Vacation Simulator*. Oculus won over the mass market—not by churning out cheap headsets that captured the barest glimmer of VR's potential, but by catering to enthusiasts in a new form factor.

Production shortages mean it's still near-impossible to buy Quest. And with Quest constantly sold out since November, Oculus Go's presence became even more of a nuisance. I don't know how many times this past holiday I had to tell people not to buy Go, that *no*, it wasn't just a cheaper version of Quest. That yes, they look pretty similar, but I promise you won't be happy with Go! Over and over and over again.

It was high time Oculus Go died. Go would've been a brilliant piece of hardware in 2015, but it was mediocre by the standards of 2018 and it's downright anachronistic in 2020. This funeral is nothing but a formality—and one that arguably should've coincided with Quest's release last year, when Go's death would've felt more like a natural stepping stone between Gear VR and Quest and less like some vestigial third vertical few people embraced.

Oculus is certainly trying to position it as the former, writing (go.pcworld.com/ocbl) that "Oculus Go made new experiences possible for people around the world, and it laid the groundwork for Oculus Quest." But really this feels more like the end of an era, the end of an earlier Oculus with earlier ideas about VR's future. Three paths diverged in the forest—Go, Quest, Rift—and only two of them were worth following.

Oculus Go was an experiment worth trying though, if only to prove the hurdle holding virtual reality back wasn't price so much as quality. With Quest still sold out, at least Oculus can take solace knowing it eventually stumbled on the right path forward.

The Quest replicates the full room-scale desktop experience.

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Dell XPS 15 9500: Buy this laptop instead of a MacBook Pro 16

Dell's completely redesigned XPS 15 9500 arrives just in time to kick the MacBook Pro 16 into its grave. **BY GORDON MAH UNG**

PCWorld EDITORS' CHOICE

Timing is everything in the PC business, and the Dell XPS 15 9500, an overdue refresh to the company's high-end workhorse, arrives just in time for it to be truly considered the "MacBook Pro killer" it's always aspired to be.

Yes, we know "MacBook Pro killer" is overused Internet clickbait. But with Apple's decision to throw in the towel on x86-based laptops, anyone buying a Mac today is basically volunteering to stand on the deck of the Titanic and wave as the last lifeboats pull away (go.pcworld.com/lfbt).

IMAGE: GORDON MAH UNG

Some laptop refreshes can be fairly minor. For the XPS 15 9500 ($2,254 at Dell.com;go.pcworld.com/22dl), it's a complete redesign of a laptop that's changed little since 2015, when it first adopted its "InfinityEdge" bezels.

On this model, gone is the 16:9 display aspect ratio that was prevalent for some years—fine for watching YouTube, not so great for productivity. In its place is a 16:10 aspect ratio, 15.6-inch panel running 4K+ with HDR400 and Dolby Vision support. The result is a stunning all-screen look that is likely to set the style for other laptop makers to emulate.

The left side of the XPS 15 9500 features (from left to right) a Noble lock port and two Thunderbolt 3 ports.

The right side of the XPS 15 9500 gives you (left to right) a USB-C port with DisplayPort and USB Power Delivery charging, as well as a UHS-III card reader and headset jack.

SPECS

The Dell XPS 15 9500 wouldn't be a Dell XPS 15 without top-shelf parts. As you can see from the spec list that follows, it's first-class all the way. Note that the eval unit we tested has a Core i7 CPU, which we think is a better choice overall than the 9th-gen Core i9 in the Dell XPS 15 7590 (go.pcworld.com/dl75) we tested last fall. The Core i9 chip seemed to push that laptop's thermals over the edge.

CPU: Intel 10th-gen 8-core Core i7-10875H

GPU: GeForce GTX 1650 Ti

RAM: 16GB DDR4/3200 in dual-channel mode and SO-DIMM slots.

Display: 4K UHD+ 3840x2400 Sharp IPS panel with touch

Storage: 512GB SK Hynix PC611 NVMe SSD

Networking: Killer WiFi 6, Bluetooth 5

Dimensions: 13.6 x 9 x 0.7 inches

Weight: 4.5 pounds, plus 1.5 pounds for the 130-watt power brick

Battery: Rated at 85 Watt-hours

Ports: For ports, pictures tell the story best. On the left side of the laptop you get a wedge-shaped lock port and two Thunderbolt 3 ports.

The right side of the XPS 15 9500 gives you a SuperSpeed USB 10Gbps Type-C port that can hit 10Gbps transfers and support USB Power Delivery charging and DisplayPort (with an adapter). You also get a UHS-III SD card reader and an analog audio jack.

SORRY, USB-A

Yes, there's no square USB-A port on the XPS 15 9500, which is sure to chap some hides. We've complained about this since Dell jettisoned the USB-A on the XPS 13, but to no avail. Dell's official reason has been to reduce the thickness of the laptop without adding drop-down jaws or port bulges. The unofficial reason, we suspect, is that if Apple gets away with it, why not Dell? When we mean "get away with it" we mean, people still buy Apple and Dell laptops by the truckloads, so maybe it's just us.

Beyond the loss of the USB-A though, is an overall trend to lose concurrent port use. The previous XPS 15 7590 (go.pcworld.com/dl75) featured two USB-A, one Thunderbolt 3, a full-size HDMI port, headset jack, SD Card slot, lock port and dedicated charging port. That meant you could charge the older model with an HDMI monitor plugged in as well as a USB keyboard and USB mouse. With the XPS 15 9500, one USB-C port will always be occupied by the charger. A monitor (with adapter) would take another port. Suddenly you're down to a single USB-C port for everything else.

What's the difference between Dell and Apple? You get an HDMI and USB-A dongle in the box with the XPS 15 9500. All Apple gives you with the MacBook Pro 16 is the power supply and a smug look.

Fortunately, Dell mitigates this a little by including a USB-C dongle with a USB-A and HDMI adapter in the box. Dongles are yet another accessory to juggle, but a free dongle is better than none at all. You can guess what Apple does.

CARD READER PERFORMANCE

Because the XPS 15 9500 is aimed at content creators, Dell spends valuable real estate to integrate an SD card reader into the laptop. Dell specs it as a UHS-III-capable slot, which means in theory, it can hit 600MBps if you have a fast-enough card. Actual UHS-III SD cards are still nearly impossible to find, though, so for our test we used a 128GB SanDisk Extreme Pro card rated for 300MBps reads and 260MBps writes. We ran CrystalDiskMark 7.0's standard test on the XPS 15 9500 and compared it to the results of a SanDisk Extreme Pro UHS-II USB reader.

The XPS 15 9500's SD card slot outperformed a fast USB reader by 21 percent in reads and 18 percent in write speeds. If you're copying over 100GB of video files you just shot, that's a significant difference.

We found the Dell XPS 15 9500's built-in UHS-III reader (left) outperformed SanDisk's Extreme Pro UHS-II USB reader (right) in performance on a UHS-II-rated SanDisk Extreme Pro SD card.

WEBCAM

Webcams are no longer the throwaway feature they were last year. In the XPS 15 9500, it's a 720p-resolution unit (as are the vast majority) that's integrated into the top bezel. The module also supports infrared and works with Windows 10's biometric Windows Hello feature. If you don't want to use your face to login, there's also a fingerprint reader built into the power button.

Overall, the webcam delivered image quality similar to that of most current laptops in normal lighting. Unless you're doing a video conference in a cave with Colonel Kurtz, it's just fine.

SPEAKERS

Laptop speakers generally run the gamut from medicore to worse. Sometimes, like in the case of the MSI GS66 Stealth (go.pcworld.com/gs66), you almost wonder if there are speakers inside--or the world's smallest Kazoo band.

With the XPS 15 9500, Dell actually integrates four speakers: two side-firing in the base, and two speakers

Which webcam looks the best to you? The Dell XPS 15 9500 (top left), the MSI GS66 Stealth (top right), the XPG Xenia 15 (bottom left) or the low-bezel mount Gigabyte Aero 17 (bottom right.)

that fire up through 4,532 holes drilled through the keyboard deck. This gives the XPS 15 9500 legitimately the best audio we've heard in a small laptop in a while. No, this won't match the annoying beat coming from the back of a lowered Honda Civic, but it gets decently loud with a good balance of highs, mids, and lows. It could use a touch more bass, but we suspect that's asking too much of a laptop this thin. As it is, the laptop is loud enough that you can feel the vibrations through the keyboard deck on your palms if it's turned up to moderately high volume. (We're not sure what could be done except add vibration insulation, which would make the laptop thicker and heavier.)

The speakers are branded Waves Nx. Dell says they were tuned by Grammy-award winning producer Jack Joseph Puig to improve its immersive sound. Whether that's just marketing fluff we can't say, but it does indeed sound very immersive, thanks to the combination of the sound coming at you from the top and the sound reflecting off a surface.

KEYBOARD AND TRACKPAD

The parts of the laptop you touch most are the keyboard and trackpad. On the XPS 15 9500, you thankfully get a standard butterfly switch instead of the company's MagLev keyboard. That means good travel and fairly stable keys when depressed.

The trackpad gets huge on the new XPS 15 9500.

Much like on the MacBook Pro, the trackpad is now huge. It supports Microsoft's Precision drivers for Windows 10's gestures and is fairly smooth, though not as buttered-glass smooth as MSI's GS66 Stealth. With its size, we were concerned about sending the cursor flying with our fat palms. But even when trying, we could not get our palms to move the cursor.

There were reported issues with loose and wobbling trackpads on early XPS 15 9500 units. Dell reportedly has said it identified (go.pcworld.com/rpid) the issue, which has been corrected on newer units. Any laptops already in the field will be fixed.

So is a large trackpad better? That's hard to say. A larger trackpad means you don't need your finger to be as precise or as focused in its movements as it would have to be on a smaller surface area. Your fingers also physically have to move farther. Overall, Dell has done its homework on tuning the trackpad.

The trackpad is still a physical clickpad as well, with a hinge design placing the pivot point at the top near the keyboard. That means it'll get progressively harder to click the trackpad as you move farther up the surface. In comparison, Apple's MacBook Pro series doesn't physically move, instead simulating clicks with haptic feedback.

Which is better? Apple's system will bug those who want their trackpads to actually move. Because the clicks are fake, however, there's no need to increase pressure near the top of the keyboard. To each their own.

DISPLAY

Before we go on to performance we do want to call out the display, which has more acronyms than a PhD student who never left the university. The panel is UHD 4K+ with a 16:10 aspect ratio. It's not an off-the-shelf

design either: While a typical 4K panel has a resolution of 3840x2160, the XPS 15 9500 features a native resolution of 3840x2400. The panel will hit 100 percent of Adobe RGB and 94 percent of DCI P3 color gamut. It meets VESA's Display HDR 400 spec, and it's also Dolby Vision-certified.

The screen is touch-enabled and sheathed in Gorilla Glass for protection. It has an anti-reflective coating to minimize glare, while still sporting that glossy look and feel people want.

Finally, the screen features Eyesafe technology, which reduces blue light emissions that keep you up at night—while still looking natural (more primitive blue-light reduction techniques look about as subtle as a fake sunset scene from a 1980s TV show). The screen is very bright and rated at 500 nits, which is about what we measured as well.

The XPS 15 9500's panel is Dolby Vision and HDR400-certified.

Compared to a standard laptop's screen, the XPS 15 9500 is a stunning difference. We also stood it up against the Gigabyte Aero 17 (go.pcworld.com/ae17), which similarly features an HDR400-rated 4K panel, and the MSI Creator 17 (go.pcworld.com/cr17) with an HDR1000 miniLED panel. Viewing various HDR1000 and HDR400 videos as well as still images, our eyes give the MSI Creator 17 the edge. There's a zing and contrast the HDR1000 miniLED panel produces that's undeniable. We'd say the XPS 15 9500 is very close to the Gigabyte Aero 17's display, but we give the latter a very slight edge. All three are spectacular, though, so you basically can't go wrong.

One thing we should mention: When you unplug the XPS 15 9500 from the power brick, the screen will go black for a few seconds before coming back on. The reason is harmless but still likely to annoy people: Anytime you switch a Windows laptop from displaying HDR content, it will automatically switch back to standard color gamuts when on battery to reduce power consumption. You can turn off this behavior by

switching off HDR completely, or unchecking the "Don't allow HDR games and apps on battery" option from the display properties.

PERFORMANCE

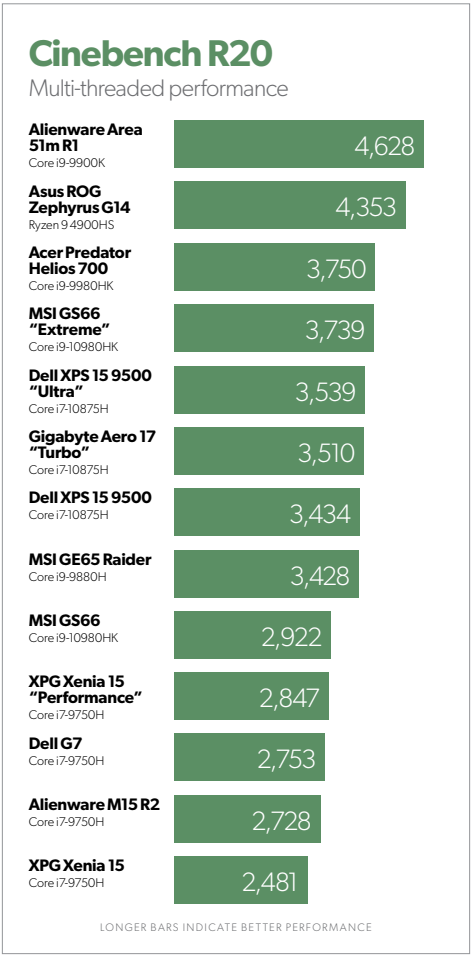
We'll kick off our performance testing of the XPS 15 9500 with Cinebench R20—which is an updated, harsher version of the older Cinebench R15 we've typically used. Both are valid measurements of CPU multi-core performance at 3D modelling (one lighter-duty and one heavier-duty), and they give you a general idea of how the laptop could perform in other tasks that are heavily multi-threaded.

For pure CPU tasks, the Core i7-10875H in the XPS 15 9500 represents well. It's right there with Gigabyte's much larger Aero 17, which uses the same CPU, and is close to the 8-core Core i9-10980HK in the MSI GS66.

As this generation of laptop is highly dependent on performance settings, we tested the XPS 15 9500 in both its default and its "Ultra Performance" states.

Overall, this is a great showing for a 4.5-pound, 15-inch laptop, as it can hang with more gaming-focused and better-cooled laptops in CPU operations. The only fly in the ointment is the Asus ROG Zephyrus G14 (go.pcworld.com/zp14) with its Ryzen 9 4900HS, which is an even smaller and lighter laptop that generally whups laptops using Intel.

Even though Cinebench R20 takes three times as long as Cinebench R15 to run, it's still a fairly short load. Modern laptops slowly taper off performance as they build up heat over longer loads. To test that impact, we use an older version of the free HandBrake utility to convert a 1080p file using the Android Tablet preset. Although even this isn't the stress test it was a few years ago, it still takes an 8-core laptop 20 minutes or more to run it.



Given that longer workload, you can see the thermal limitations of a thinner laptop in the results. The larger and heavier Aero 17, with the same CPU as the Dell XPS 15 9500, opens up a 15-percent lead over the Dell. To be fair, the Aero 17 when set to its own "Turbo" mode is quick to trigger its fans and makes quite a racket. You might think the 8-core XPS 15's 6-core-level result is terrible, but this is the reality of a laptop this small running an 8-core CPU. On long-running CPU loads, it's going to give up ground.

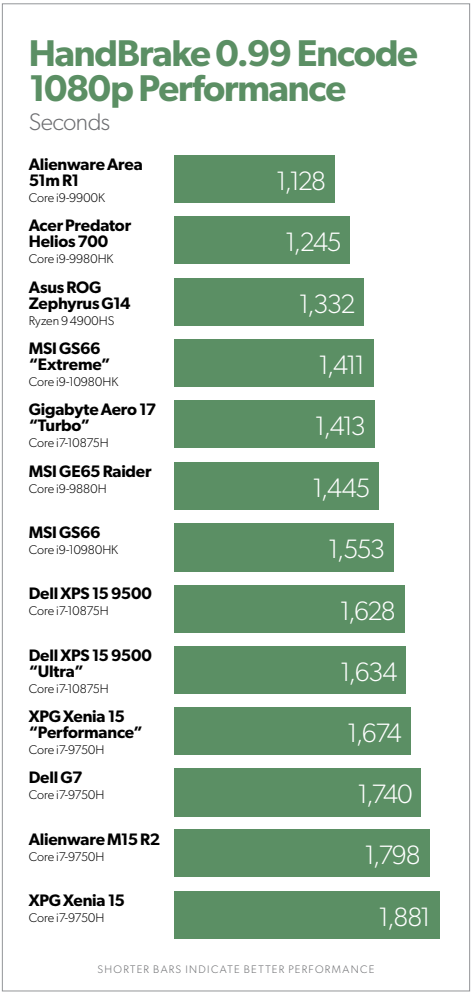
For gaming, we'll throw in the results from running *Rise of the Tomb Raider* at 1920x1080 resolution, set to Very High. This older test is run in DX11 mode without exclusive full-screen mode selected.

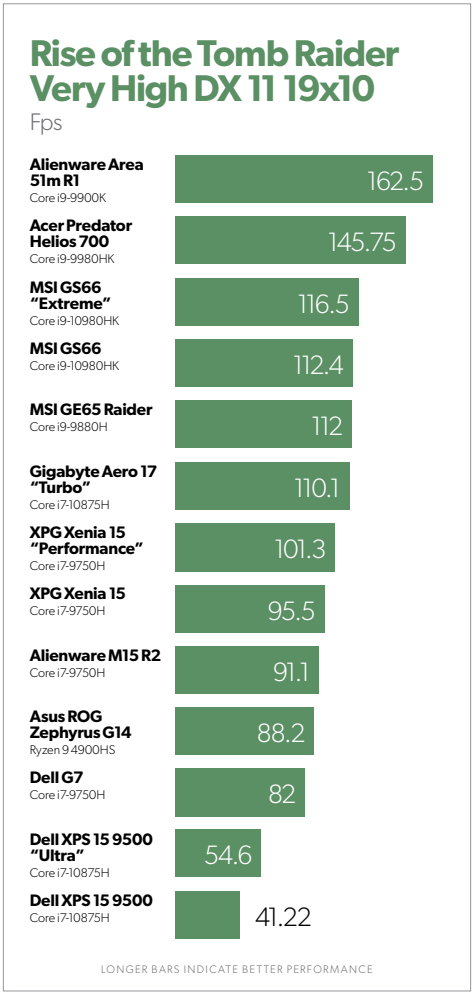
First you probably noticed that Dell's "Ultra Performance" setting didn't make much of a difference in CPU tests. But in this GPU load, we see a big difference.

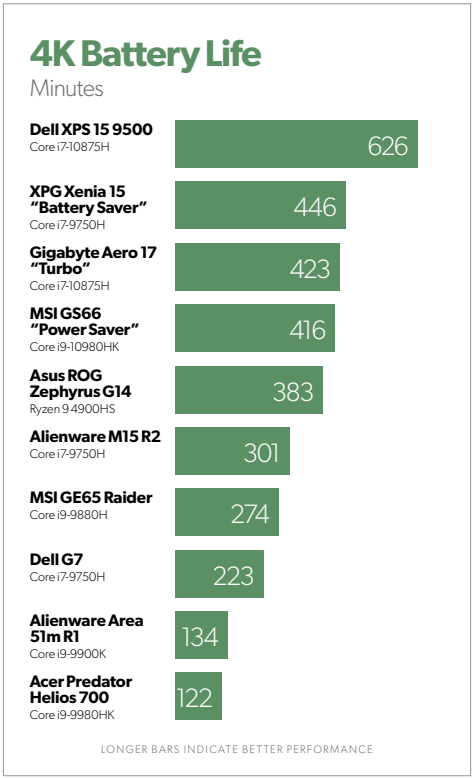
Second: The result should be no surprise. Every laptop in this chart except the XPS 15 9500 are primarily gaming laptops, with big, hairy GPUs. They also tend to make more noise and generally have screens better for gaming, but poor for content creation.

Why are we even comparing the XPS 15 9500 to gaming laptops? Because people often do, just as they would do with the MacBook Pro 16. If that MacBook Pro 16 were in this list, it would be at the bottom or near the bottom.

Of course, the problem for the 4.5-pound XPS 15 9500 and the 4.3-pound MacBook Pro 16 is that gaming laptops—while certainly far thicker and larger—aren't too far off in weight. The MSI GS66 Stealth weighs the same as the XPS 15 9500 despite its GeForce RTX 2080 Super Max-Q. The XPG Xenia 15 is just over 4 pounds with a GeForce RTX 2070





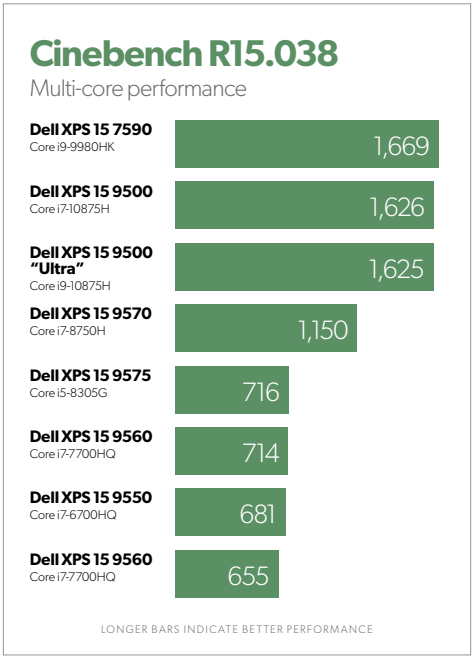


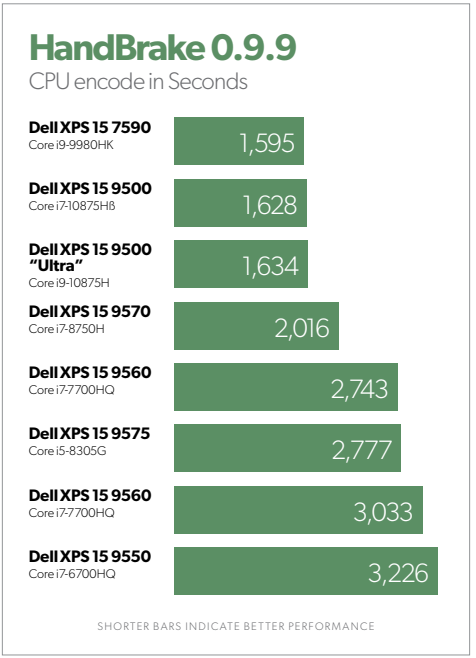
Max-Q. So yes, it's fair to show the Dell here.

BATTERY LIFE

The XPS 15 9500 gets its revenge in perhaps the most critical test of all for a laptop: battery life. For that we loop a 4K video at a fairly bright 250 to 260 nits, in airplane mode and with earbuds in place.

The XPS 15 9500 simply crushes those gaming laptops, with about 10.5 hours of video playback. Incredibly, that's with a 4K panel—which typically eats a third of run time—and an 84-watt-hour battery. Many of the gaming laptops you see here are packing much bigger gas tanks. The MSI GS66 Stealth runs the maximum allowed on an airplane: 99.9 Watt-hours. So yes, the XPS 15 9500 gets the last laugh.





SHOULD I DUMP MY OLD XPS 15 FOR A NEW ONE?

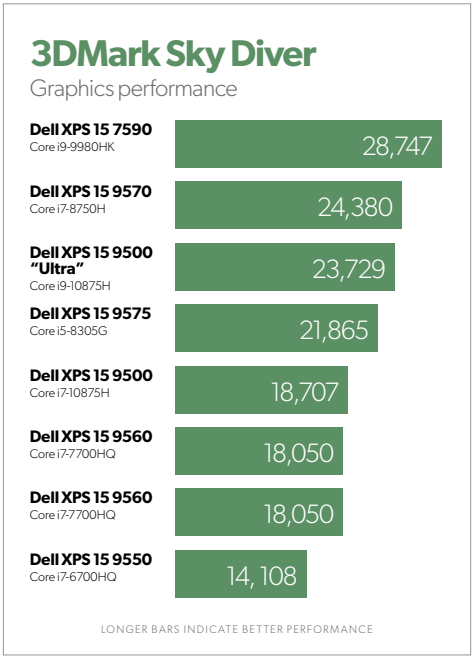
We've reviewed enough XPS 15s over the years to give you some context for how much of an improvement the new 9500 delivers over prior generations. The results aren't as obvious as you'd think.

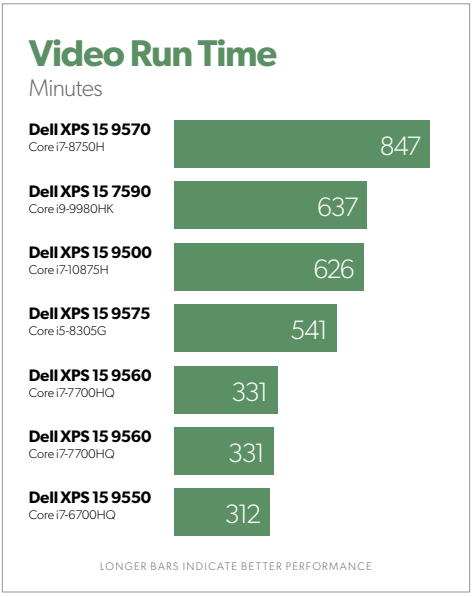
First up is the older Cinebench R15 CPU test. News flash: An 8-core XPS 15 (like last year's 7590) is faster than a 6-core XPS 15 (including this year's 9500), which is faster than all of those old 4-core XPS 15s.

Although last year's XPS 15 7590 is actually faster, that's because it features a Core i9 CPU. Note that this year's model seems to give you about the same performance from a Core i7.

While the XPS 15 9500 gave up ground in the longer HandBrake encode test to larger gaming laptops, the performance against its own cousins is actually quite good. Here you can see that it's actually as fast as last year's Core i9-based 7590.

For graphics, the picture gets a little more muddled. The previous XPS 15 7590 eats the new XPS 15's lunch, and the two-year old XPS 15 9570 is tied with the new XPS 15 9500 even when set to Ultra Performance. This particular test result focuses solely on GPU





performance and excludes CPU performance from its score, so we're a bit surprised by the result here.

We'll end with a video rundown test. As we said earlier, 4K panels eat power. You can see it here, where the XPS 15 9500 with its 4K IPS panel, and last year's XPS 15 7590 with its 4K OLED panel, easily lose three hours of battery life when compared to the XPS 15 9570 with its FHD screen. Even so, we've come a long way from the fairly miserable five-hour battery life of an XPS 15 9560 with its 4K panel. So yes, the new XPS 15 9500 is extremely good for a laptop with a 4K panel.

BOTTOM LINE

There's a lot to unpack with the XPS 15 9500. CPU performance is very good—it doesn't significantly move the needle over the previous model, but you're getting more bang for your buck from the current Core i7 over the earlier, pricier Core i9 configuration.

On gaming performance, it looks like the XPS 15 9500 actually takes a step back for unexplained reasons. However, disappointing gaming doesn't mean bad encoding, so video editors can rest easy. Gamers: Buy an Alienware.

The primary focus of this generation of

Dell's XPS 15 9500 is perfect for content creators who spend a lot of time on the move.

XPS 15 is the outside, an upgrade that was long overdue. The keyboard and trackpad are quite good, the sound is probably the best on a PC laptop this size, and the screen is gorgeous with its no-bezel look. It's slim and relatively light even with its 130-watt USB-C power brick. It is, basically, probably the perfect laptop for content creators on the move.

So yes, we're sticking with our original clickbait line, that the MacBook Pro 16 killer has finally arrived. We just didn't expect Apple would help push its own laptop overboard along with Intel.

Dell XPS 15 9500

★★★★☆

PROS

- Gorgeous slim-bezel display.
- Fantastic audio for a laptop.

CONS

- GPU performance takes a step back.
- Not even one measly USB-A port.

BOTTOM LINE

The Dell XPS 15 9500 is finally the MacBook Pro killer it's always wanted to be, with a gorgeous display, better keyboard and trackpad components, and strong productivity performance. We miss USB-A, though.

$2,254

Lenovo Yoga C640: The battery life blows us away

Leave the AC adapter at home. **BY BEN PATTERSON**

At first glance, it's easy to dismiss this particular model of Lenovo's Yoga C640, a Best Buy exclusive with a relatively anemic dual-core i3 Comet Lake CPU, a puny 128GB SSD, and a $600 price tag. That said, this sleek convertible (officially the Yoga C640-13IML) has an ace up its sleeve: a beefy battery that just goes, and goes, and goes.

While this made-for-Best Buy system isn't a great pick for users looking to process 4K videos or crunch big numbers (there are other Yoga C640 configurations better suited for such CPU-intensive tasks), it could be a great fit for users looking for a versatile 2-in-1 that can go all day long without an AC cord.

IMAGE: BEN PATTERSON

SPECS AND FEATURES

Lenovo offers three versions of the Yoga C640-13IML (go.pcworld.com/3vrs; we'll just call it the Yoga C640 from here on out) on its website, including an $850 version (or $770 after discounts) with a 10th-gen Core i5-10210U processor, 8GB of DDR4 RAM, and a 256GB solid state drive, and a $1,000 model ($910 with rebates) with the same RAM and SSD but an upgraded i7-10510U CPU. There's also a $1,050 configuration that ups the RAM on the Core i7 version to 16GB. All three models come with the same touch-enabled 13.3-inch Full-HD IPS display.

Our review version (81UE000WUS) of the Yoga C640-13IML isn't listed on Lenovo's website; instead, it's a $600 Best Buy exclusive (go.pcworld.com/600x) that's considerably less expensive (and, consequently, less powerful) than the other three models.

Here are the details:

CPU: Dual-core Intel Core i3-10110U (Comet Lake)

Memory: 8GB DDR4

Graphics: Integrated Intel UHD Graphics

Storage: 128GB SSD

Display: 13.3-inch 1920x1080 IPS, touch-enabled

Webcam: 720p, dual-array microphone, physical camera shutter

Connectivity: One SuperSpeed USB 5Gbps (formerly known as USB 3.2 Gen 1) Type-C port, two SuperSpeed USB 5Gbps (formerly known as USB 3.2 Gen 1) Type-A ports, combo audio jack

Networking: Wi-Fi 5 (802.11ac)

Biometrics: Fingerprint reader

Battery capacity: 60 Watt-hour

Dimensions: 12 x 8.1 x 0.7 inches

Weight: 2.88 pounds (3.22 pounds with AC adapter)

Overall, this is a typical configuration that we see in budget laptops. The dual-core 10th-gen Comet Lake Core i3 CPU is perfectly capable of everyday computing tasks such as web browsing, Office, and light photo editing, although it'll start to chug when it comes to demanding multi-core operations like video processing or crunching databases. The 8GB of RAM offers a decent amount of headroom for multitasking or juggling multiple browser tabs.

The 128GB SSD will get cramped awfully fast. Once you take into account Windows 10 and other apps pre-loaded onto the C640, the drive only has about 77GB of free space left. If you store a lot locally, you might want to invest in an external hard drive or cloud storage.

Physically, the 0.7 inch-thick and 2.88-pound C640 is about the same size and weight as other 2-in-1 systems in its class. The fingerprint reader is always a nice bonus. While Wi-Fi 5 networking is standard for laptops in this price range, just remember that you won't be able to take advantage of the enhanced speed and efficiency features

offered by cutting-edge Wi-Fi 6 routers.

We've left the best for last, though: namely, the Yoga C640's 60 Watt-hour battery, which bodes well when it comes to battery life. Later on, we'll put the battery to the test and see whether it lives up to its promise.

DESIGN

The Lenovo Yoga C640 boasts the same overall design scheme as Lenovo's other Yoga models, including its angled front edge, flat sides, and the signature Yoga 360-degree hinge. Thanks to the hinge, you can swivel the display all the way around and use the C640 as a tablet, tent it on a desk or tabletop, or sit it keyboard-down with the display angled up for kiosk mode.

The C640's sandblasted aluminum shell did a nice job of resisting fingerprints, although I could also spot faint greasy hand smudges here and there. While the C640's flat, nearly featureless lid (save for the Yoga logo) feels smooth to the touch, the bottom half of the chassis has a slight rubberized feel, which helps to keep the laptop from slipping out of your hand.

A couple of other design features worth mentioning include the Yoga C640's power button, which sits on the right side of the laptop near the hinge, a position that makes it tough to press by accident.

The 2-in-1 design lets you swivel the display all the way around for tablet use, tent it on a tabletop, or sit it keyboard-down with the screen tilted up.

Also worthy of note is the "TrueBlock" privacy shutter for the 720p webcam sitting in the display's top bezel. The shutter is so subtle that it's easy to miss, and it doesn't offer any visual cues whether it's open or shut. That said, the shutter is easy to slide (I had a much tougher

The physical camera shutter on the Yoga C640 is a nice bonus for a $600 laptop.

time dealing with the shutter on the Yoga C640's pricier cousin, the Yoga C740 [go.pcworld.com/c740]), and given this laptop's budget price range, it's a rare treat to get a webcam shutter at all.

DISPLAY

Any budget laptop display whose brightness measures north of 250 nits (or candelas) is a plus in our book. All too often, we see bargain laptops with screens that can't even hit that low-water mark.

Luckily, the Lenovo Yoga C640's full-HD display, which is surrounded by slim bezels along the top and sides with a chunkier bezel on the bottom, is reasonably bright for a laptop in its price range, measuring 305 nits according to our readings. Granted, we've seen plenty of laptops with displays that measure well north of 300 nits (as in 400 or even 500 nits, in some cases), but they'll generally cost you hundreds more than the Yoga C640 does.

The Yoga C640's IPS (in-plane switching) display delivers solid viewing angles. The screen dims only slightly when viewed from the sides or the top or bottom, with no signs of inverse colors. The touch-enabled display also did a nice job of responding to my taps and swipes.

KEYBOARD, TOUCHPAD, SPEAKERS, AND EXTRAS

I've been impressed by the feel of the keyboards on other Lenovo Yoga models, and the Yoga C640's keyboard is no exception. They're a pleasure to type on, with a slight concave design, easy discovery, and generous travel (that is, the distance that a key moves when it's pressed). Each keystroke delivers a crisp, tactile bump, with a refreshingly springy rebound. They keyboard offers two-step backlighting, along with hotkeys for volume, mic mute, airplane mode,

Windows lock, and screen brightness. There aren't any media playback hotkeys, unfortunately.

The Yoga C640's touchpad sits just below the space bar, putting it slightly left of center. I had little trouble swiping and clicking the touchpad, and I never noticed any jitteriness from false inputs. Even when I intentionally brushed my palms against the bottom corners of the trackpad, the cursor remained rock-steady.

The Yoga C640's upfiring speakers sounded pretty good for laptop speakers, with a fair amount of detail and even some subtle bass response. Even better is the Yoga C640's support for Dolby Atmos, an object-based sound format that allows for precise sound placement in a 3D soundstage. Dolby Atmos is generally thought of as an audio format designed for theaters and home audio setups with in-ceiling speakers, but Atmos is finding its way into plenty of devices with only stereo speakers, including phones and laptops. Of course, the Yoga C640's stereo speakers can't approach the fidelity of a proper home theater or even external computer speakers, but the laptop's Atmos-enabled drivers manage to deliver solid audio with an impressively wide and detailed soundstage—well, for laptop speakers, anyway.

PORTS

The Lenovo Yoga C640 has a middling selection of ports. On the left side, you get the first of two USB SuperSpeed 5Gbps (formerly USB 3.2 Gen 1) Type-A ports, along with a combo audio jack and a barrel-shaped power port.

The backlit keyboard is a pleasure to type on, while the touchpad did a nice job of rejecting false inputs. (And yes, that's a Dolby Atmos logo.)

On the right side sits the second USB SuperSpeed 5Gbps Type-A port, along with a USB SuperSpeed 5Gbps Type-C port.

While we're always happy to see a pair of USB Type-A ports (good for connecting, say, a mouse and a printer), along with a USB-C port (handy for newer external hard drives), we're

The left side of the Yoga C640 features a USB SuperSpeed 5Gbps Type-A port and a combo audio jack.

A second USB SuperSpeed 5Gbps Type-A port sits on the right side of the C640, along with a USB SuperSpeed 5Gbps Type-C port. No media card reader, however.t

disappointed by the lack of a memory card reader or an HDMI port. Also missing is a slot for a laptop security cable. You'll likely want to invest in a USB-C hub (go.pcworld.com/bhub) to extend your connectivity.

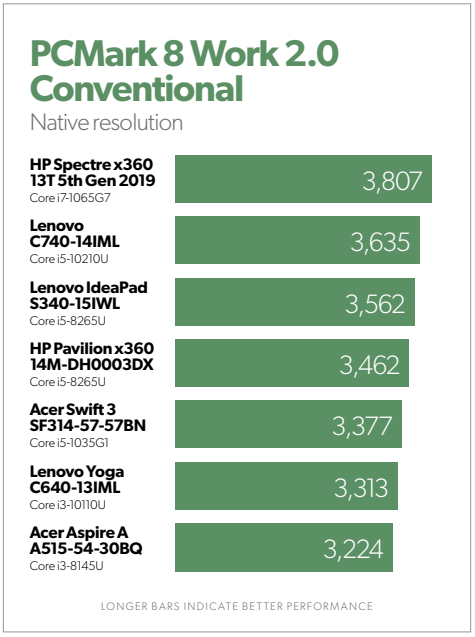
GENERAL PERFORMANCE

With its dual-core Core i3 Comet Lake processor and integrated Intel UHD graphics, the Lenovo Yoga C640 isn't going to be a screamer in terms of CPU-intensive tasks or graphical performance.

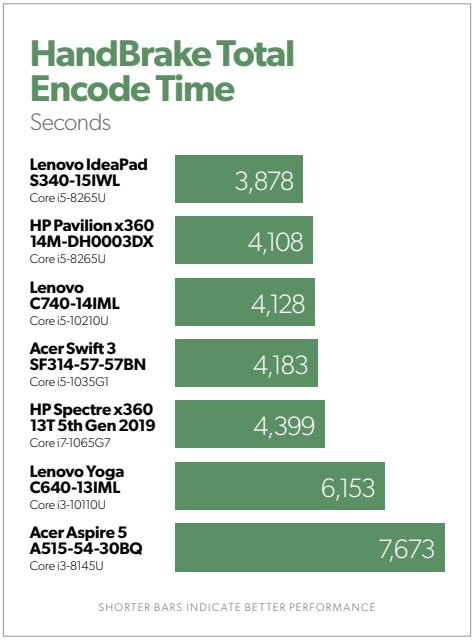
As you'll see, however, the Yoga C640 acquits itself quite nicely when it comes to everyday computing chores (which is what most of us spend 99 percent of our time doing anyway), and as for battery life, well… you'll see.

PCMARK 8 WORK 2.0 CONVENTIONAL

Our first benchmark simulates such everyday computing tasks as web browsing, spreadsheet tinkering, online shopping, and video chat. A PCMark 8 score of 2,000 or better typically means you'll see



The Lenovo Yoga C640's PCMark 8 score may not be a chart-topper, but it still bodes well for smooth Office performance.



Laptops with dual-core CPUs generally get lower scores during our HandBrake benchmark, and the Yoga C640 is no exception.

buttery-smooth Office performance from a given laptop. It's also worth noting that the types of daily PC activities simulated by PCMark 8 are single-core tasks, which means that laptops with quad-core or better CPUs won't necessarily enjoy an advantage over a dual-core laptop like the Yoga C640.

Looking at our performance chart, the Yoga C640 finishes in second-to-last place, just ahead of another dual-core laptop, the Core-i3-8145U-powered Acer Aspire 5. But check out the Yoga C640's PCMark 8 score, which is well north of 3,000. In fact, all the laptops in our comparison nabbed a 3,000+ score. Once you hit that mark, you're not going to notice much difference in terms of performance. In other words, every laptop in our chart should do a great job of handling everyday computing chores, the Yoga C640 included. My real-life testing of the Yoga C640 confirms its impressive PCMark 8 showing.

HANDBRAKE

Our next benchmark measures the performance of a laptop as it encodes a 30GB

MKV video file using the free HandBrake utility. This is a lengthy and processor-intensive task that reliably spins up the fans as CPU temperatures begin to soar. Generally speaking, laptops with the most processor cores will rise to the top of the chart.

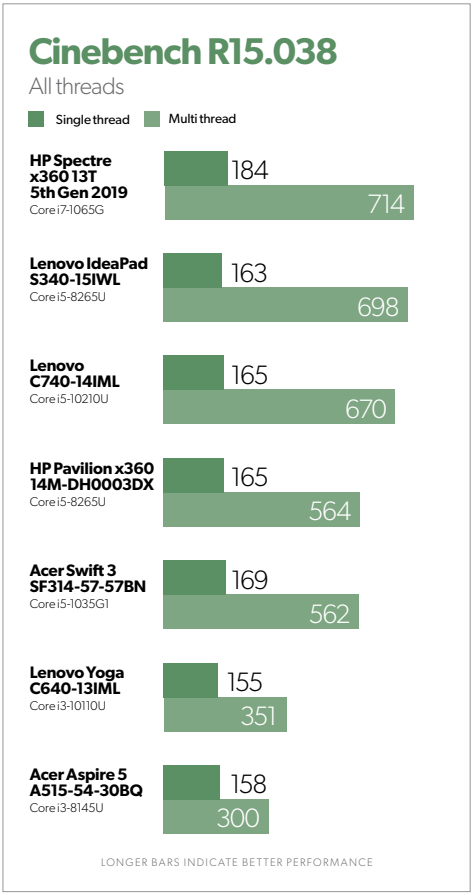
Unsurprisingly, the Lenovo Yoga C640 sits second-to-last. All the laptops that snagged a better HandBrake score (remember, lower numbers are better in this particular test) have quad-core processors.

Now, we should note that the Yoga C640's HandBrake showing isn't bad for a dual-core laptop (we've seen scores above 8,000 for other dual-core systems). Keep in mind that when it comes to web browsing, Office work, and most other day-to-day computing tasks, multi-core performance just doesn't matter that much. That said, if you are planning on encoding videos or crunching large databases on the C640, you'll have to be patient.

CINEBENCH

While our HandBrake benchmark generally takes more than an hour to perform, our Cinebench test (which involves rendering a 3D image in real time) is often over in a matter of minutes. That makes Cinebench handy for measuring how a laptop deals with short bursts of intense activity, both in single-core and multi-core scenarios.

Again, the dual-core Lenovo Yoga C640 winds up near the bottom of our chart, slightly ahead of the dual-core Acer Aspire 5. While



As with HandBrake, our CineBench test reveals the limitations of dual-core laptops like the C640 when it comes to multi-threaded performance.

we're not surprised by the Yoga C640's "all-threads" Cinebench score, we are a little concerned with its single-thread result, which is a hair below that of the Acer's. The single-thread Cinebench mode measures the efficiency of a single CPU core, and it's odd

that the Aspire 5, a laptop with an older Core i3 chip that has a slightly slower boost clock, would beat out (just barely) the Yoga C640's Comet Lake i3 CPU.

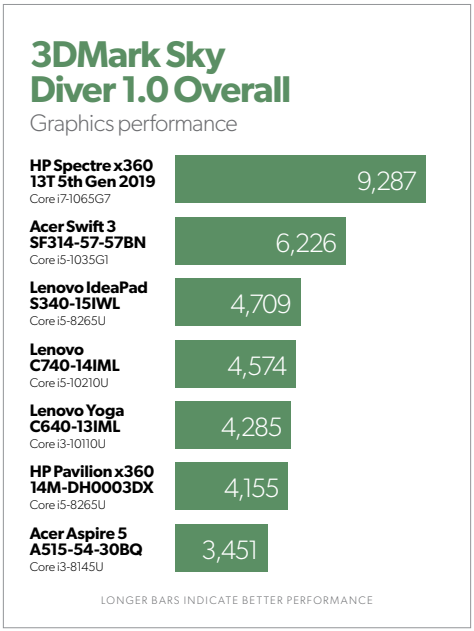
Now, remember that the Yoga C640 passed the PCMark 8 single-core benchmark with flying colors, and I never noticed any hiccups during my day-to-day testing of the system. So while we are surprised by this result, we'll keep our red flag stowed for now.

3DMARK SKY DIVER 1.0

With its integrated Intel UHD Graphics core, the Lenovo Yoga C640 won't cut it as a gaming laptop (although you can game on just about any laptop now, thanks to such streaming gaming services as Nvidia's GeForce Now and Google Stadia [go.pcworld.com/nwst]). We still wanted to check its graphics prowess using 3DMark's Sky Diver 1.0 benchmark.

The results are pretty much what we expected, with the Yoga C640 bunched up with several other laptops with Intel's standard UHD core. The two laptops at the top of our chart—the HP Spectre x360 and the Acer Swift 3—both benefit from Intel's newer high-end integrated graphics chips, the G1 and the cutting-edge Iris Plus, the latter of which has been nipping at the heels of discrete graphics cards.

The upshot is that the Yoga C640 will do just fine when it comes to light photo editing and streaming video, as well as Minesweeper-level casual gaming.

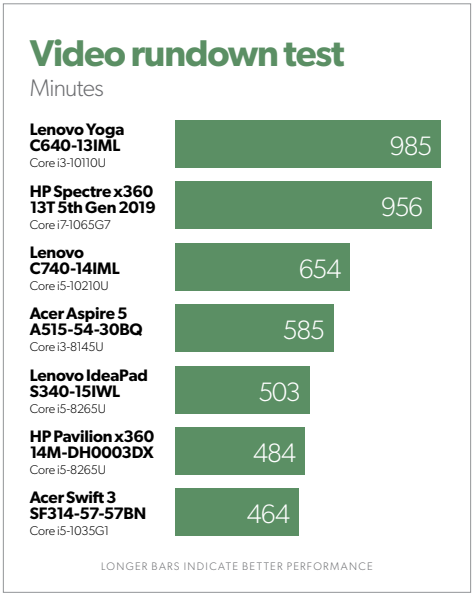


With its integrated graphics core, the Lenovo Yoga C640 can handle light photo editing apps, video streaming, and casual games such as *Minesweeper*.

BATTERY LIFE

We test battery life on a laptop by looping a 4K video using the stock Windows Movies & TV app, with screen brightness set to about 250 nits (which meant dialing the C640's brightness setting down to 94 percent) and adjusting the volume to 50 percent with wired earbuds plugged in.

Thanks to its beefy 60-Watt-hour battery (larger than any of the other laptop batteries in our comparison chart), the Lenovo Yoga



The Lenovo Yoga C640's battery life score speaks for itself.

C640 shot to the top of our chart, notching an eye-popping 985 minutes (or 16.4 hours) of battery life. That's a score that eclipsed even the HP Spectre x360, our former battery-life champ when it comes to Intel Core-powered laptops.

Of course, your mileage will vary. If you stream video, crank up the screen brightness, or do anything processor-intensive, the battery will drain more quickly. Still, I tried using the Yoga C640 during a few of my usual eight- or nine-hour workdays (during which I'm generally writing stories and doing a lot of web browsing), and the battery almost always made it to the end, no AC cord needed. That's a pretty neat trick.

BOTTOM LINE

This Best Buy-exclusive version of the Lenovo Yoga C640-13IML may be saddled with a dual-core i3 processor and cramped storage, but it's blessed with stellar battery life. While it may drag its heels when it comes to multi-core tasks, it cruises right along during everyday computing activities. We're also happy with its reasonably bright screen and Atmos-enabled speakers. We'd say this is a good choice for budget users who stick to basic productivity tasks. The long battery life makes it a particularly good choice for students spending the day on campus, or a gig worker hopping from a cafe to a lobby sofa to a commuter train (pandemic permitting).

Lenovo C640-13IML

★★★★☆

PROS

- Superb battery life.
- Solid everyday computing performance.
- Physical camera shutter.

CONS

- Dual-core processor struggles with CPU-intensive tasks.
- No memory card slot.

BOTTOM LINE

This Best Buy-exclusive version of the Lenovo Yoga C640-13IML may be saddled with a dual-core i3 processor and cramped storage, but it's blessed with stellar battery life.

$599

HP Chromebook x360 12b: It's affordable and good

The 3:2 aspect-ratio display and solid design make it a Chromebook fit for work or play.

BY MELISSA RIOFRIO

The HP Chromebook x360 12b is an affordable Chromebook made for grown-ups. It takes you a cut above the rock-bottom basic Chromebooks that hover around $250 (and continue to sell well). Get one of those for your kids—who cares if they destroy it? But you, the adult in the room, deserve the Chromebook x360 12b, with its surprisingly good design and great battery life.

This is still a budget-grade Chromebook, so there are some compromises: Performance is mediocre, and the 3:2 display, while nice and tall, isn't very bright. Still, we think HP

IMAGE: MELISSA RIOFRIO

made reasonable choices to provide a productive and enjoyable experience without breaking the bank.

The right side of the HP Chromebook x360 12b houses USB-A and USB-C ports, as well as a lock slot and volume rocker.

SPECS AND FEATURES

The Chromebook x360 12b we tested currently goes for $360 at Adorama (go.pcworld.com/36ad). As you'll see from the somewhat modest specs and features below (and the performance charts later on), HP spent less on the CPU, memory, and storage, and more on the design.

CPU: Intel Gemini Lake dual-core Celeron N4000

RAM: 4GB

Display: 12-inch, 3:2 aspect ratio, HD+ (1366x912) touchscreen

Webcam: HD (720p) WFOV (Wide Field of Vision), 88 degrees

Storage: 32GB eMMC

Networking: 802.11ac 2x2 Wi-Fi, Bluetooth 5

Connectivity: Two USB 3.1 Gen 1 Type-C (5Gbps, DisplayPort 1.2, Power Delivery 3.0), one USB 3.1 Type-A, one headphone/microphone audio jack, microSD

Dimensions: 10.7 x 8.5 x 0.68 inches

Weight: 2.98 pounds, per HP

The HP Chromebook x360 12b locates the power button on the left side, toward the middle.

The Chromebook x360 moves easily into tent mode. As the speakers will be firing away from you in this position, however, you'll need to pump up the volume a bit.

DESIGN

The specs tell just part of the story for the Chromebook x360 12b. HP put a lot of thought into key details, starting with the sturdy chassis. The body is mostly plastic, but the aluminum keyboard deck helps it feel very solid, even when held by one corner. The overall weight is light enough for easy toting.

The base is colored silver, while the plastic display lid is painted white. I'm always afraid I will ruin anything white, but the lid, perhaps because of its matte finish (or my habitually frequent handwashing), just picks up a little shine sometimes where I touch it.

HP makes a strategic trade-off with the display. With a measured luminance of 229 nits, it's just barely bright enough to work in a well-lit office, and don't even try to take it outside. The bezels are average, not super-slim. Instead, HP prioritized giving it a 3:2 aspect ratio. We're used to seeing 16:9 in many laptops, but that wider screen makes it hard to be productive if you have to navigate long documents or big spreadsheets. The Chromebook x360 12b's taller screen makes it easier to get real work done, and I'll gladly take that over a few extra nits.

The USB port selection is worth noting. HP keeps one toe in the past with the single USB-A port, but having two USB-C ports keeps users in step with the present trend. The charger connects via one of those USB-C ports, so if you plan to have it plugged in most of the time you might want to buy a USB-C hub (go.pcworld.com/byhb) to give yourself plenty of options.

HP builds a wide speaker across the top of the keyboard tray. Its audio quality is what you'd expect from a laptop of this size—a bit tinny, with meager bass—but at least the sound is coming right at you, rather than from the sides as in some designs. When the Chromebook x360 12b is configured in tent mode, the speaker faces away from you, diminishing the sound slightly. I turned up the volume a bit to compensate.

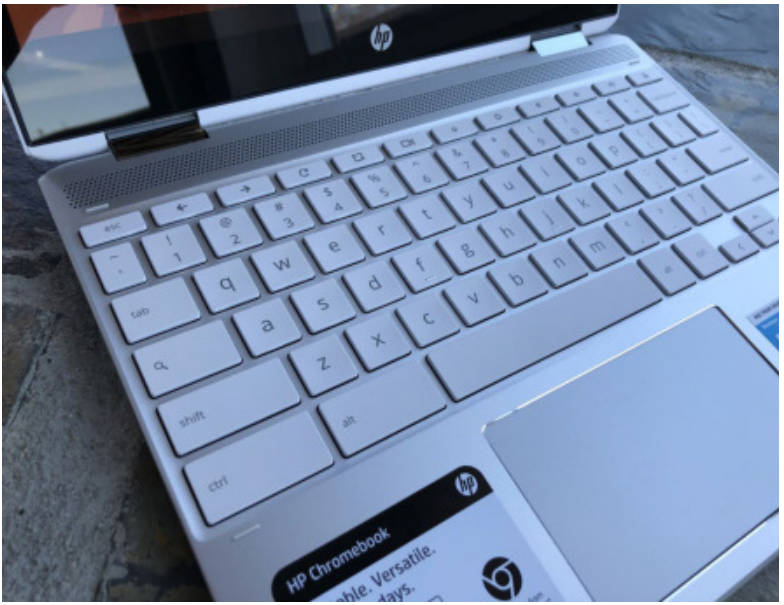
KEYBOARD, TRACKPAD, WEBCAM, PEN

I tend to approach low-cost Chromebooks with dread, as the keyboards can be awful—with harsh travel akin to typing on rocks. The Chromebook x360 12b's keyboard rises several steps above, providing firm and gentle feedback that kept me comfortable through hours of intensive typing.

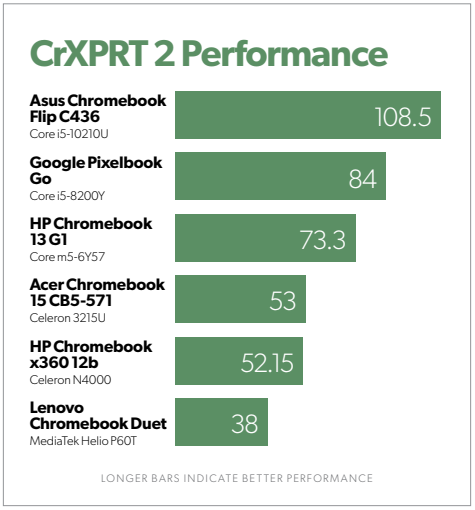
The trackpad is huge and centered on the spacebar. It clicks almost all the way to the top. We've had uneven experiences with HP trackpads—they occasionally seemed to lose palm rejection or run amuck selecting text—but this one exhibited smooth, predictable responsiveness.

The webcam is your standard 720p resolution, with an 88-degree field of view. It delivers good image quality for typical videoconferencing use.

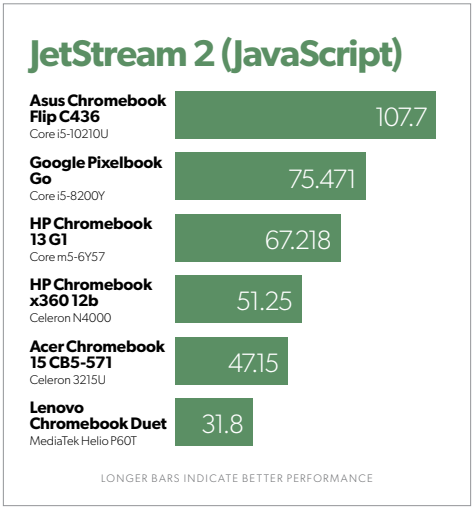
Note that the Chromebook x360 12b supports pen input, and I tried it successfully with an HP stylus I had available. It supports any USI-compatible pen—HP offers one for about $70 through HP.com (go.pcworld.



The HP Chromebook x360 12b offers a surprisingly comfortable keyboard for the price, and a very large trackpad.



The HP Chromebook x360 12b performs in line with expectations for its Celeron N4000 CPU, providing adequate power for mainstream productivity.



In the JetStream 2 benchmark, the HP Chromebook x360 12b stayed in line with similar processors, leading the rear of the pack overall with adequate performance.

com/hpen). A magnetic area along the left side of the keyboard deck allows the pen to stay rooted in place.

PERFORMANCE

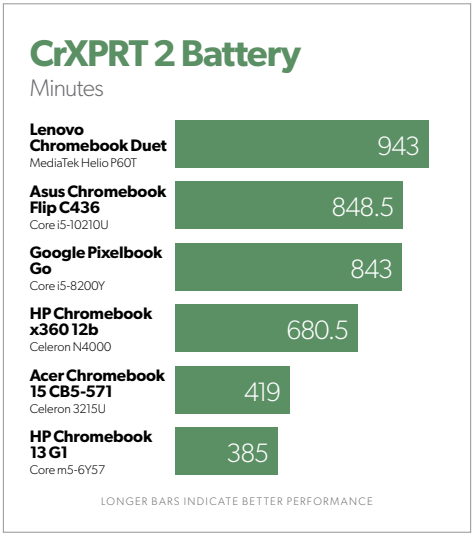
Given the Celeron N4000 CPU, you should expect adequate, rather than blazing, performance from the Chromebook x360 12b. Within the Chrome ecosystem, that's usually enough. In my typical workday I move among multiple web applications, with 15 or 20 tabs open in my browser. I worked many days on the Chromebook x360 12b with no noticeable lag. If you're streaming video or playing online games, you'll probably notice more of a strain.

Note that because Google updates Chrome OS every six weeks, the results aren't perfectly comparable. However, we've also spot-checked older Chromebooks on newer OS versions and usually notice just small upticks in performance over time.

The results fall into line based on the CPU, and the Celeron N4000 in the Chromebook x360 12b therefore tends to dwell near the bottom. Because of the consistency of the results across all tests, I'll show just a few here.

First up is CrXPRT's Performance test, which alternates productivity workloads with periods of low activity, to simulate an on-again, off-again rhythm of laptop use.

In CrXPRT Performance and every other



The HP Chromebook x360 12b lasted a good 11-plus hours in the CrXPRT 2 battery rundown test

test we ran, the HP Chromebook x360 12b basically stayed in line with the older Acer Chromebook 15 (which has an earlier generation of Celeron processor), and lagged behind models with more powerful Core-level processors. At least it can hold its head high against the Lenovo Chromebook Duet, which uses an even slower Mediatek processor.

Here's the same story all over again in JetStream 2, a JavaScript and WebAssembly benchmark aimed at more advanced web applications.

BATTERY LIFE

The HP Chromebook x360 12b moves up a notch in battery life, posting a solid 11-plus hours in the CrXPRT 2 rundown test.

Note, however, that the laptops it beats are older models. The Chromebooks that exceed it, by two or more hours, are contemporary and mostly more expensive. The Chromebook that beats everyone on battery is the significantly cheaper Lenovo IdeaPad Chromebook Duet (but remember, its performance is the slowest of the lot).

BOTTOM LINE

The HP Chromebook x360 12b is a good fit for people who want something affordable, but also noticeably nicer than what kids might use in school. It's small, light, and versatile, and even comfortable to work on for long periods. I also know I'm going to miss the display's 3:2 aspect ratio when I go back to a wider-screen laptop.

HP Chromebook x360 12b

★★★½☆

PROS

- 3:2 display makes it productive for higher education and working from home.
- Quality keyboard with good travel.
- Sturdy chassis.

CONS

- Mediocre performance.

BOTTOM LINE

The HP Chromebook x360 12b is an affordable Chromebook for grown-ups, with good design and quality where it counts. Its modest performance will see you through most browser-based tasks, and the 3:2 display means you can work productively.

$360

Samsung SSD 870 QVO: Stupendous 8TB capacity SSD

SSDs are closing ground on hard drives in capacity per unit, albeit not in price per terabyte. **BY JON L. JACOBI**

The Samsung 870 QVO ('Q' as in 4-bit QLC), is our first look at a drive that will eventually ship with a whopping 8TB of NAND on board. Announced June 30, this is the new top capacity available, superseding a still-new flock of 4TB models. Samsung sent us the 2TB version for testing. It's a great everyday performer; however, when you run out of cache (which shouldn't be often), write pace falls off drastically.

SPECS AND PRICING

A standard 2.5-inch SATA 6Gbps SSD, the 870 QVO is currently available for preorder in a few of its capacities: the 2TB we tested ($250 from Newegg [go.pcworld.com/25eg]), and 4TB ($500 from Newegg

IMAGE: KINGSTON

[go.pcworld.com/4teg]). The 1TB capacity is on sale now for $130 on Amazon (go.pcworld.com/1tam) or $130 from Newegg (go.pcworld.com/1teg) in $130/1TB, $250/2TB (tested), and $500/4TB flavors. The 8TB model will be available in August for $900. That's considerably cheaper than the high-capacity 4TB OWC Aura P12 (go.pcworld.com/ap12) and 8TB Sabrent Rocket Q NVMe (go.pcworld.com/srkq) drives we recently covered, and a far greater savings delta than we normally see between NVMe and SATA.

Samsung uses its own MKX controller, and there's 1GB of DRAM cache for each 1TB of 96-layer, QLC (Quad-Level Cell/4-bit) stacked/layered/3D NAND on board. The drives seemingly allocate about 4.5 percent of the NAND as SLC cache, if our tests with the 2TB drive are indicative.

SLC cache is MLC/TLC/QLC treated as SLC by writing only one bit instead of four, or if you prefer, on/off rather than one of 16 possible states. This is much, much faster operation, as there's little to no error-checking required. The contents of the SLC cache are later transferred to non-cache NAND.

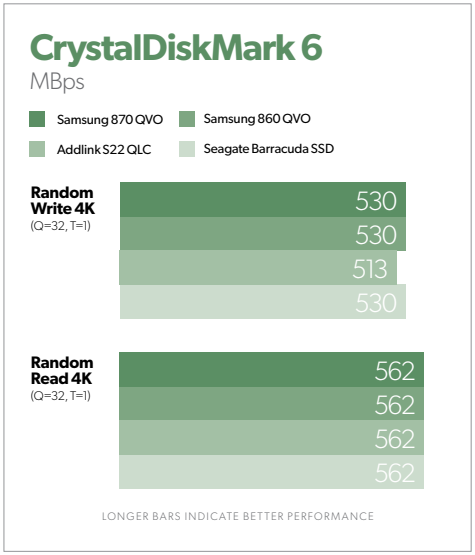
The 870 QVO is warrantied for three years, and is rated for 360TBW (TeraBytes Written) per 1TB of capacity. Samsung bundles its Magician software, which provides control of overprovisioning (the amount of NAND set aside for replacement of dead cells), secure erase, and diagnostics.

Samsung's 870 QVO is a definite improvement upon the older 860 QVO, and it offers excellent everyday performance.

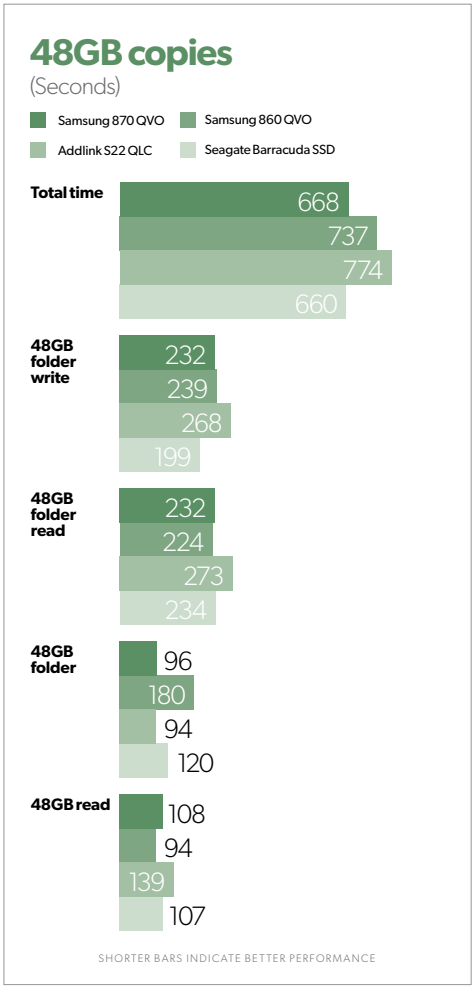
PERFORMANCE

First, the good news about the 870 QVO's performance—and in truth, good news is all the average user will encounter. CrystalDiskMark 6 measured the drive as matching the speed of the competition. Most SATA SSDs already bump up against the bus's 6Gbps bandwidth limitation—hence, the nearly identical scores.

In the real-world 48GB transfer tests, the 2TB 870 QVO improved over its older 860 QVO sibling. However, the 860 QVO we tested was a 1TB drive that ran out of cache at about the 45GB mark (I discussed the 4.5 percent cache), dropping to 75MBps for the last leg of the race.



CrystalDiskMark 6 doesn't reveal a lot of difference in performance between the drives shown. Largely because modern SSD capabilities largely exceed the bandwidth of the SATA bus.

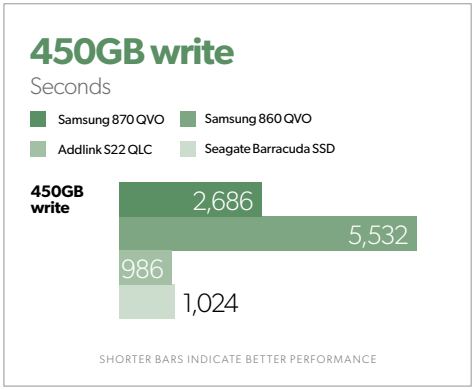


With 48GB data sets, the 2TB 870 QVO is a match for Seagate's Barracuda SSD. The 1TB version likely would've run out of cache before the end of these transfers and turned in a longer time in the 48GB single file write.

The 1TB 870 QVO would no doubt have run out about the same time, but it probably still would have turned in a slightly faster score than the 860 QVO because of its faster write rate, off cache.

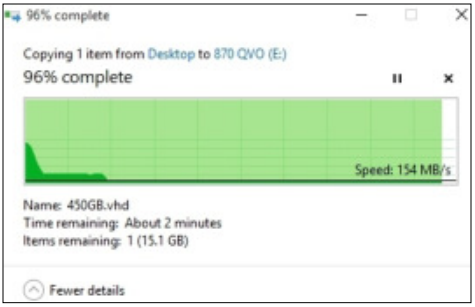
Where things turned a bit sideways was in the 450GB write, a test we've been running for a while as drive capacity and the amount of cache provided skyrocket. As you can see in the chart, the 870 QVO was faster than its predecessor, but still far slower than the other drives.

You can see in the capture opposite exactly why the Samsung QVO drives are so much slower writing the extra large 450GB file. When out of cache, the 870 QVO drops to 150MBps, while the 860 QVO drops even further to a paltry 75MBps.



While the 870 QVO is twice as fast as the 860 QVO writing a 450GB file, it's far, far slower than the competing TLC drives. It's not the drive for heavy workloads.

While the 870 QVO clearly isn't the drive for writing lots of large amounts of data, how often will you actually do that? Once in a blue moon, if at all. The slowdown is painful when it occurs, but you'll likely not see it in the larger capacities. The DRAM makes the drive very responsive while running an operating system, with its myriad small file calls.



The Samsung 870 QVO's sustained write performance drops to roughly 150MBps when it runs out of cache. The huge bump at the beginning of the copy is the Windows and DRAM caching having effect.

Testing is performed on Windows 10 64-bit running on a Core i7-5820K/Asus X99 Deluxe system with four 16GB Kingston 2666MHz DDR4 modules, a Zotac (Nvidia) GT 710 1GB x2 PCIe graphics card, and an Asmedia ASM2142 USB 3.1 Gen 2 (10Gbps) card. Also on board are a Gigabyte GC-Alpine Thunderbolt 3 card and Softperfect's Ramdisk 3.4.6, which is used for the 48GB read and write tests.

BOTTOM LINE

The Samsung 870 QVO's capacity is great, as is its everyday performance. You'll likely be perfectly happy with the drive if you install it in your laptop or PC as the main drive. But 8TB? Come on now. That's pretty sweet. Just be aware of the severe dropoff in speed when writing outside of the cache.

Samsung SSD 870 QVO (2TB)

★★★★☆

PROS

- Great everyday performance.
- Up to a stupendous 8TB of capacity.

CONS

- 150MBps writing after running out of SLC cache.

BOTTOM LINE

The Samsung 870 QVO SATA SSD offers great everyday performance combined with up to 8TB of capacity. However, while it's faster than its predecessor, its write performance after running out of cache is extremely weak.

$250

Avira Prime: Value, value, value

Avira Prime offers a lot for the money, and the protection is good too. **BY IAN PAUL**

We've been reviewing Avira Antivirus Pro (go.pcworld.com/at19) for a few years now and wondering why it was worth purchasing when the free version of Avira offered so much. At the time, Avira's top-level offering, Prime, was just too expensive. Those days are over, however, and Avira Prime is now available at a competitive price.

Prime is the company's one-stop shop for antivirus, web protection, ad blocking, privacy protection, and system maintenance. It includes access to Phantom Pro, the company's VPN, as well as system tune-up options, a secure file shredder, and more.

Avira also recently overhauled its interface, offering a much nicer look, and a vast improvement on Avira's previous design.

FEATURES AND SERVICES

Avira Prime starts with a very simple dashboard with three icons: Security, Privacy, and Performance. There's also a left rail with

IMAGE: GETTY

the same icons. Alerts show up next to each icon on the dashboard when there are issues, such as the need to run a security scan. Instead of clicking on each icon to deal with the problems, however, you must click the button towards the bottom.

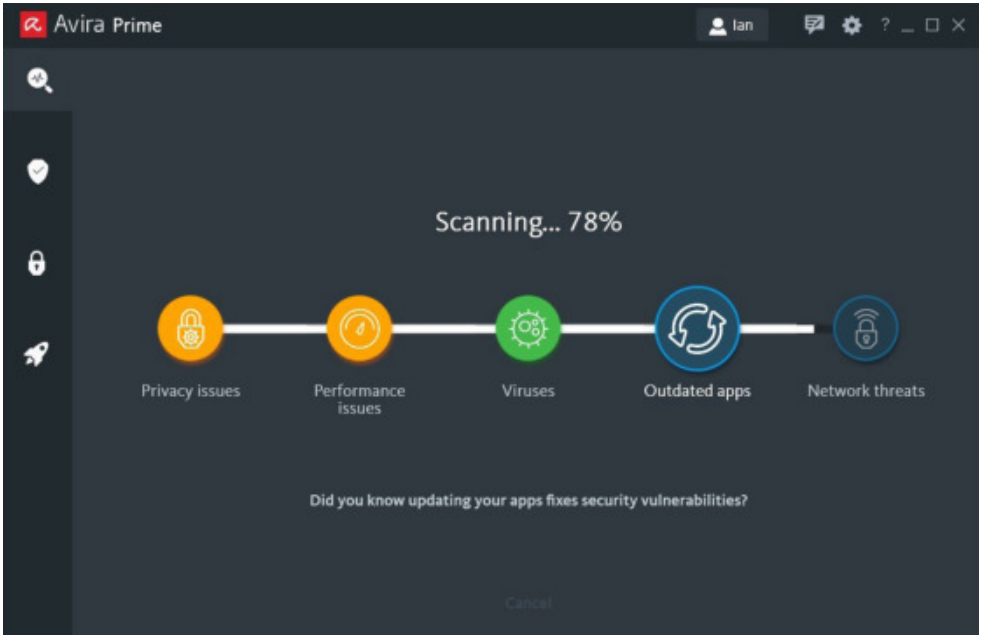
That button initiates another scan called a Smart Scan, which summarizes the potential issues with your PC, and then lets you fix the issues with one click. There's also a full-details option if you'd like to control which actions the software carries out.

It'd be nicer if you could deal with each issue in its respective section. It would also make more sense to dump the left rail and only have the three icons leading to each section. Still, it's pretty easy to use and understand, and the fact that it can deal with multiple issues with a few clicks is nice.

Moving past the dashboard, Security has the meat of the antivirus protections. Here you have the virus scan options, including full scans, quick scans, and the ability to schedule scans and create custom scans.

A Protection options tile leads to the various types of protections the suite offers with on/off sliders for each. These include real-time protection, web protection, ransomware protection, and email protection.

Security also houses the quarantine tile,



A Smart Scan in Avira Prime.

the firewall, and the third-party software updater.

The firewall section doesn't do much as it relies on Windows Defender for the firewall. It does list the PC's known Wi-Fi networks, with a switch to set them as public or private (the firewall behaves differently based on the type of network). Click the Advanced Settings link, and the Windows Defender Firewall settings pop up.

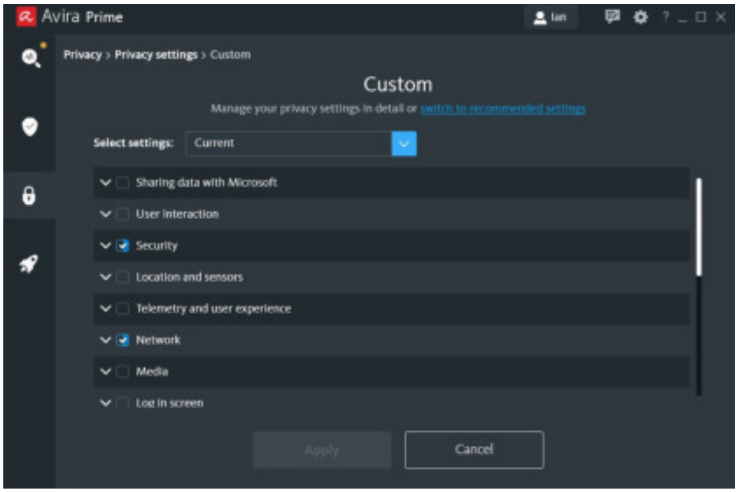
The Privacy section offers a good number of protections. The Browser safety tile installs Avira's add-ons for Chrome and Firefox, including Avira Safe Browsing, which blocks ads and trackers. This add-on also lets you know if the website you're on is safe or not.

Prime subscribers don't have any limitations on the amount of VPN they can use. The VPN is built into the desktop application and doesn't require a separate download.

This is also where you find the password manager, and the file shredder for deleting sensitive files, rather than waiting for the file system to overwrite them.

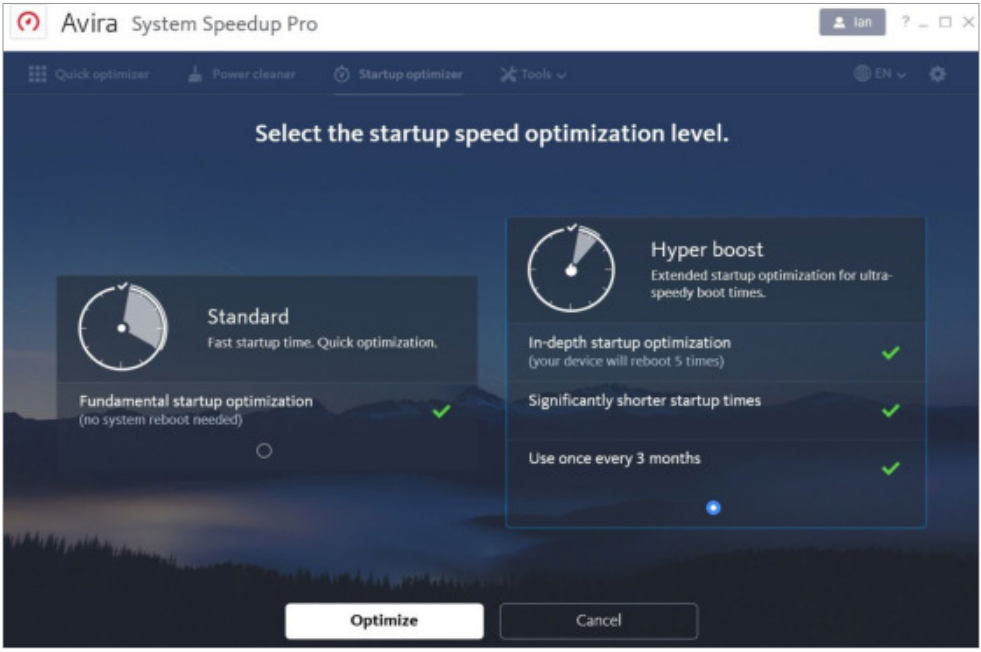
Next, is the Privacy settings tile, which offers some really nice items. You can just set it and forget it and do what Avira recommends. Jump into the custom section, however, and you can see how much detail this section offers.

You can choose to be incredibly overzealous by preventing the PC from even syncing the system time with the internet, as well as not sending error reports, and postponing Windows Updates. And that's just the Sharing Data With Microsoft section. You can also disable all Windows telemetry options, and a whole lot more. Privacy conscious users will really appreciate this tool.



Avira Prime's Windows 10 privacy controls.

Avira also recommends downloading and installing the Opera browser as part of Prime. This isn't a default install of Opera. Instead the browser includes Avira's add-ons by



Avira Prime's Startup optimizer.

default, such as Avira Browser Safety, Avira Password Manager, and Avira Phantom Pro VPN.

Finally, we get to the Performance section. This houses all of Avira's various system speed-up tools, including the optimizer, Startup optimizer, battery saver, driver updater, and duplicate file finder.

The last tool is nice since duplicate file finders often cost money, and the Startup optimizer was a treat to use. It's far nicer than the Startup tab in the task manager. It not only helps you edit which programs should launch, but shows your most recent startup time in seconds. There are also a number of automatic features, including a Hyper Boost to cut down on boot times as much as possible. Hyper Boost requires about five reboots to analyze your system, making it kind of a pain, but it worked well in our experience. All of these system tools open in a separate application called System Speedup Pro.

Jumping into the application's settings cog, there is absolutely nothing here except the option to change display languages. That's it. Important system controls accessible by the user are contained within the main

portion of the desktop application.

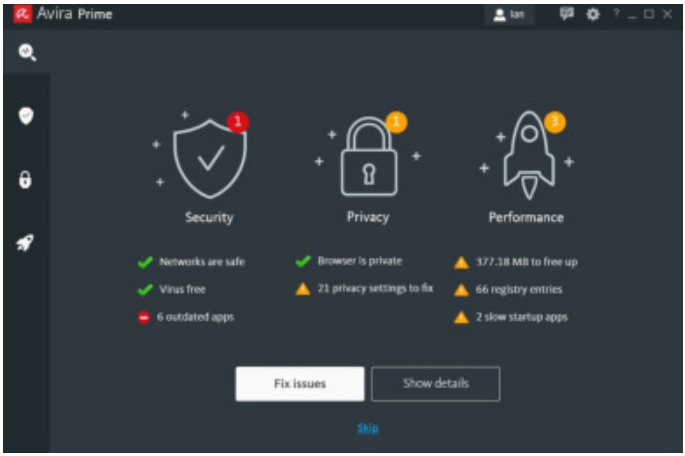
PERFORMANCE

For AV-Test's March and April 2020 results (go.pcworld.com/ap20), Avira Antivirus Pro (which uses the same security engine as Prime) scored 99.1 percent and 99.5 percent, respectively, in the 0-day attacks test. That test used 304 samples; the industry average was 98.4 percent. In the widespread and prevalent malware test, Avira scored 100 percent based on more than 20,000 samples.

Moving over to AV-Comparatives (go.pcworld.com/acom), in the Malware Protection test with more than 10,000 samples for March 2020, Avira Prime blocked 99.97 of threats, with 24 false positives. That performance puts it on a par with Kaspersky and Vipre, with AVG and Avast performing slightly above that, and F-Secure, G Data, K7, Panda, and Total AV doing even better. In AV-Comparatives' real-world protection test for February and March 2020, Avira scored 100 percent based on 372 samples.

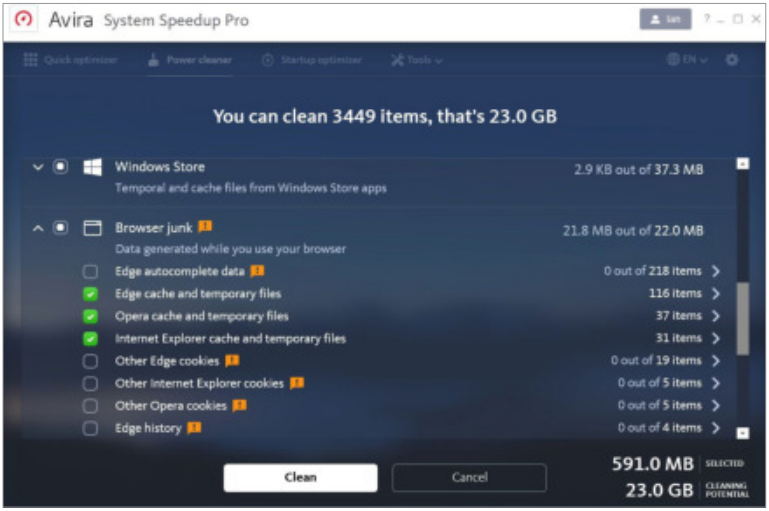
SE Labs (go.pcworld.com/5lab) gave Avira a AAA rating in its January to March 2020 report. Despite the rating, Avira wasn't in the first tier of AAA suites that included AVG, Eset, F-Secure, Kaspersky, Sophos, and Trend Micro. Avira led the next tier (due to missing one public thread, but stopping all others), putting it in the same class as Microsoft and Norton.

For our in-house performance tests there are only two benchmarks worth talking about. The first is PCMark 10's Extended test, which had an odd result. Before we installed Avira Prime, the PC scored 2,238. That's an unusual score, as the PC usually doesn't do better than 1,620 or so. With Avira Prime installed the score went down to 1,581. That's quite a drop, but we're going to ignore the 2,238 as an outlier, and compare it to the usual 1,620 score. Even so, that's still quite a noticeable drop down to 1,581.



Avira Prime's initial dashboard after installation.

The large-file transfer time was also slower. Without Avira installed the time was 11 minutes, 3


Avira System Speedup Pro
You can clean 3449 items, that's 23.0 GB
Windows Store
2.9 KB out of 37.3 MB
Temporal and cache files from Windows Store apps
Browser junk
21.8 MB out of 22.0 MB
Data generated while you use your browser
Edge autocomplete data
0 out of 218 items
Edge cache and temporary files
116 items
Opera cache and temporary files
37 items
Internet Explorer cache and temporary files
31 items
Other Edge cookies
0 out of 19 items
Other Internet Explorer cookies
0 out of 5 items
Other Opera cookies
0 out of 5 items
Edge history
0 out of 4 items
Clean
Cancel
591.0 MB
23.0 GB

Avira Prime includes the Power Cleaner feature from Avira's System Speedup Pro.

seconds, and with Avira the time went up to 12 minutes, 45 seconds, an increase of one minute and 42 seconds.

The bottom line is we'd expect to see some performance impact on mid- to low-range machines with Prime installed.

PRICING

Avira Prime has several pricing tiers. For five devices, it costs $80 for one year, $152 for two, and $225 for three. There's also a monthly option at $8 per. If five devices isn't enough, then you can choose the 25-device tier, which is still pretty reasonable. For 25 devices, one year is $104, two years is $201, three is $289, and the month-to-month option is $10. Those prices are close to the first-time subscriber costs of the other major antivirus suites. The difference here is that Avira's prices are the same whether it's your first subscription period, or your fifth.

BOTTOM LINE

Avira Prime is a very good suite. We did see some performance impact with it running, but you get a lot of value with this suite and the overall protection is solid. There are higher-scoring options in third-party tests, but for the entire package Avira Prime is a very good choice.

Avira Prime

★★★★☆

PROS

- Offers very good value.
- Good antivirus protection.

CONS

- Lacks its own firewall
- Performance for midrange PCs may be impacted.

BOTTOM LINE

Avira Prime is the company's top-level offering for consumer PCs. It offers solid antivirus protection, as well as a ton of extra features including a password manager, VPN, startup optimizer, secure file shredder, and many other system optimization tools.

$79

Best Galaxy S20, S20+ and S20 Ultra cases: Top picks in every style

Protect your expensive phone from tragedy. **BY MICHAEL SIMON & JASON CIPRIANI**

We're just gonna say it—you're crazy to take your Galaxy S20 out in public without something to protect it. With prices starting at $1,000 and going all the way up to $1,600, it's one of the most expensive phones ever made. It's also the biggest, with the S20 Ultra tipping the scales at a whopping (and eminently droppable) 6.9 inches. So check out these picks and stop playing chicken with your phone.

IMAGE: ROB SCHUL

SMARTISH WALLET SLAYER VOL. 1

Price: $20 from go.pcworld.com/smcs

Colors: Black, various

Why we love it: The Smartish Wallet Slayer doesn't just have a cool name, it lives up to it. The case has enough room for three credit cards on the back, but its soft material keeps it from getting too bulky. The texturized sides are nice to grip, and the buttons are firm yet easy to push. Whether you buy it in black, choose one of the designs, or customize it with your own artwork, you'll be very happy with this stylish wallet case.

GEAR4 CRYSTAL PALACE

Price: $40 from go.pcworld.com/g4cr

Colors: Clear

Why we love it: All Gear4 cases come with D3O protection, which is the same material used in helmets and protective gear. You can immediately tell that the Crystal Palace has a sturdy and premium feel to it, without being too bulky. But it's a little more slippery than other cases, one more reason why Gear 4's claim that this case will protect your phone from a 13-foot drop is so important. But our favorite part of this case is how slick it looks, with a shimmery rainbow effect that changes depending on how you're holding it.

X-DORIA DEFENSE SHIELD

Price: $30 from go.pcworld.com/xdoe
Colors: Iridescent, red, black
Why we love it: Like a true defense shield, the Defense Shield case from X-Doria has two parts to it. There's the standard polycarbonate material that makes up the majority of the case, and then a metal ring that goes around the back that adds an extra layer of protection and a little bit of color.

The case comes with a protective film on the clear material to protect it from scratches during shipping. While we didn't notice any major marks during our testing, it makes us wonder how easily the back may scratch in everyday use. But even so, the Defense Shield is a solid case that adds a little extra character to your S20.

GEAR4 PICCADILLY

Price: $40 from go.pcworld.com/g4pc
Colors: Clear, black, blue
Why we love it: Remember Apple's bumper cases for the iPhone 4? Then you'll have a pretty good idea of what the Piccadilly looks and feels like. But it doesn't just protect the sides of your S20 with colored bumpers, it also has a clear back that'll keep your phone free of cracks and scratches. We wish there were more color options available, but the Piccadilly looks great in blue or black. So if you're looking for a clear case that adds a pop of color, this is it.

BODYGUARDZ HARMONY

Price: $40 from go.pcworld.com/bdhm

Colors: Black, iridescent

Why we love it: The Harmony case from BodyGuardz might look simple, but it's an excellent companion for your S20. It's made of a single soft shell that easily slips onto the phone. But there's nothing simple about how it protects. Raised, colored bumpers ward off side impacts, while Unequal's Kevlar backing keeps cracks at bay. The metal accents on the buttons and speaker grilles are a nice touch, and the buttons have a resounding click when pressed. The case's cool gradient pattern nicely accents your S20's chosen color.

ESR MIMIC TEMPERED GLASS CASE

Price: $17 from go.pcworld.com/esrc

Colors: Clear

Why we love it: We've always liked ESR's inexpensive and sturdy cases, and the Mimic case is no exception. At first glance, it looks like a clear, soft-shell case that doesn't add much in the way of protection. However, the tempered-glass material is sturdy enough to withstand most accidental scratches and drops, with a snug fit and nice buttons. Its clear design lets the S20 shine through. Did we mention it's only $17?

GEAR4 HOLBORN

Price: $45 from go.pcworld.com/g4hl
Colors: Black
Why we love it: The Holborn case from Gear4 is made of a soft material on the outside, but it's lined with Gear4's D3O protective material on the inside. The shell is comfortable and easy to grip, and it just plain feels good to hold. The buttons are firm and have a mechanical keyboard-like click to them that we can't get enough of. It might look simple, but with an understated elegance and excellent drop protection, the Holborn really does have it all.

ESR METAL KICKSTAND CASE

Price: $19 from go.pcworld.com/esrm
Colors: Clear, black
Why we love it: Sometimes you just want to kick back and stream your favorite YouTube channel without having to prop your phone up against something. That's where the ESR Metal Kickstand case comes in. A handy kickstand built into the back pops out to prop your phone horizontally or vertically so you don't have to worry about it slipping halfway through your movie. The rest of the case is very simple, if not a little slippery, but if you want an inexpensive way to watch movies on the go, it's a great option.

ESR ESSENTIAL ZERO CLEAR

Price: $10 from go.pcworld.com/esrz

Colors: Clear

Why we love it: The ESR Essential Zero Clear is one of the cheapest cases we've tried for the S20, and it's also one of the thinnest. The edges of the case are a little flimsy, so you might have to check it for dust and debris every now and then. But it looks really sharp on the phone, and at this price, even if you scratch up the case and need a new one, buying a second will still be cheaper than buying most of other cases reviewed here.

BODYGUARDZ ACE PRO

Price: $35 from go.pcworld.com/bdap

Colors: Translucent black

Why we love it: The BodyGuardz Ace Pro is a minimal case that looks good and eliminates the S20's slipperiness by giving it just the right amount of texture. The sides have an almost sticky feel to them, which helps keep you from fumbling, while the translucence allows some of the S20's color to shine through. Our only complaint is the buttons, which are a little too rigid to press. They should break in over time.

We may be keeping our distance,
but we are in this together.

Stay Calm.

Stay Connected.

Stay Active.

#AloneTogether

ad COUNCIL

Go to AloneTogether.com for ways
to take care of yourself and others.

XBOX GAME PASS FOR PC

FIVE REASONS IT'S THE BEST DEAL IN PC GAMING

LOTS OF GREAT GAMES, VERY LITTLE CASH. **BY BRAD CHACOS**

IMAGE: MICROSOFT

When I say an Xbox Game Pass for PC subscription (go.pcworld.com/xbsb) is the best deal in gaming today, that's no idle recommendation. I have a deep-seated hatred of today's subscription culture. Yes, many streaming and subscription services are worth every penny, but in general, I hate that everything from Microsoft Office to Adobe's Creative Cloud to freaking underwear tries to tie you up with monthly payments. So when I say Game Pass is worth it, I really mean it. Step aside, Humble Bundles.

At first, I actually refused to pony up for Xbox Game Pass for PC, because again, I've had just about enough of subscriptions. But I succumbed to its siren song when Obsidian's *The Outer Worlds* debuted (go.pcworld.com/otrw), thanks to its day-one inclusion on the service. The service's hooks sunk deeply and quickly. Paying a mere $5 a month for access to over a hundred games is a ludicrously good value. Now, Xbox Game Pass for PC is just as much of a mainstay in my house as Spotify and Netflix. I can't see ever letting my subscription lapse.

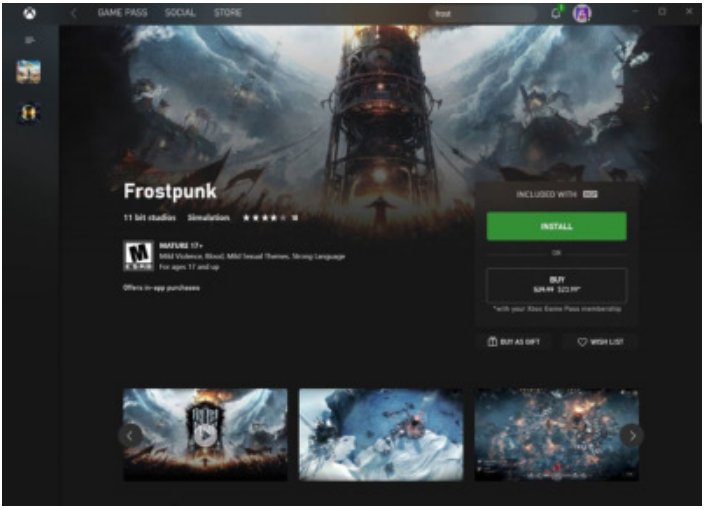
Here are five reasons why:

1. DAY-ONE ACCESS TO MICROSOFT GAMES

Historically, most gaming subscription services offered access only to ancient games that you've probably played before.

The superb *Gears Tactics* costs $60 (go.pcworld.com/grtc), but it was on Xbox Game Pass for PC on day one.

Microsoft's first-party exclusives come to Xbox Game Pass for PC the day they release, meaning Xbox Game Pass for PC members can start playing new titles in the *Halo*, *Forza*, and *Gears* franchises immediately, among others. More specific to PC gamers, Microsoft now owns Obsidian and InXile studios, two of the most celebrated developers of modern CRPGs, so you can dive into *The Outer Worlds* and the hotly anticipated *Wasteland 3* as part of your subscription.



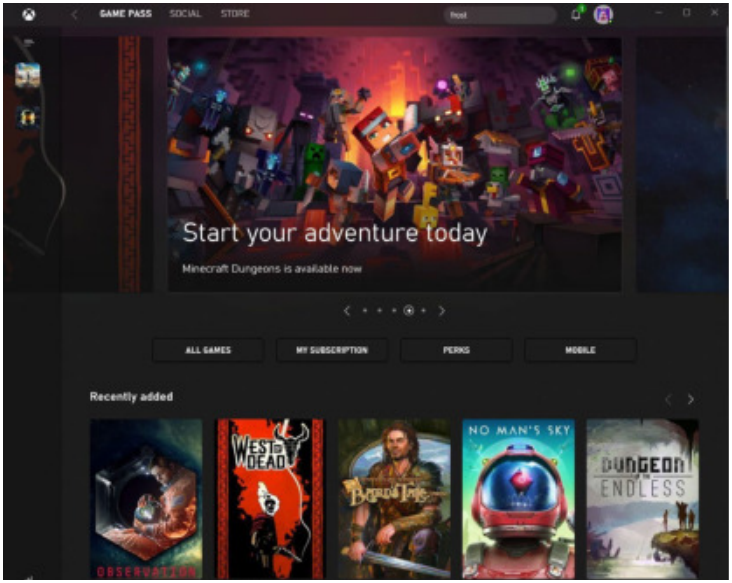
Excellent indie games like *Frostpunk* abound on Xbox Game Pass for PC.

Xbox Game Pass for PC also includes hot games from other developers, like *Yakuza 0*, *Ark: Survival Evolved*, *No Man's Sky*, and *Metro: Exodus*. Its stockpile of big-budget games from other publishers isn't nearly as deep as its first-party selection, but that's mitigated by my next point. You can see the full list of Xbox Games Pass for PC titles here (go.pcworld.com/xgme). As I write this, it stands at a whopping 193 games.

2. ABUNDANT, EXCELLENT INDIE GAMES

For PC gamers who like deep cuts, Xbox Game Pass for PC offers an incredible selection of critically acclaimed indie games, spanning a wide variety of genres. If you like giving quirky new games a whirl or don't feel comfortable paying full price for games from lesser-known studios, Xbox Game Pass for PC is your answer. (Seriously: Go play *A Plague Tale: Innocence*, *Frostpunk*, *Slay the Spire*, and *Dead Cells* if you haven't already!)

The vast selection of indie games makes Xbox Game Pass for PC much more appealing in my eyes than rival subscription gaming services like EA's Origin Access (go.pcworld.com/orac) or Ubisoft's Uplay+ (go.pcworld.com/ubup), whose libraries tend to include only games from those specific developers. Microsoft's subscription offers a wider range of games, though Origin's plan also includes a nice indie selection.



Games are added regularly and new releases put front and center.

3. NEW (GOOD!) GAMES ARE ADDED REGULARLY

There's always something fresh to play on Xbox Game Pass for PC. New games are added all the time. The curated selection ensures they'll always be *good* games—even indie titles you haven't heard of before are worth playing.

In the past month alone, *Observation* (go.pcworld.com/obsv), *Minecraft Dungeons*, *Alan Wake*, *Cities: Skylines*, *Dungeon of the Endless*, *Battletech*, *No Man's Sky*, and *The Bard's Tale Remastered* are just some of the new games that landed on the service. They're all great, and collectively offer hundreds upon hundreds of hours of gaming fun before you even start digging deeper into the backlog.

Third-party games don't tend to arrive on Xbox Game Pass for PC until they've been out for a while, so if you're the sort of gamer who needs to play the new hotness *now*, the service holds slightly less appeal. That said, it's a great way to play lesser-known titles you might not be inclined to pay full price for. Just be aware that games can shift back out of Xbox Game Pass for PC support as well—similar to how shows dip in and out of Netflix—so don't wait too long to get around to an intriguing-looking game.

4. FREE SPOTIFY AND MORE

Microsoft throws in some nice extra perks as part of your Xbox Game Pass for PC subscription. Right now, you can claim six free months of Spotify Premium, along with free goodies for online games like *Warframe*, *World of Tanks*, *Phantasy Star Online 2*, and *Smite*.

You can also save 10 percent on any

games you decide to buy that are part of Xbox Game Pass for PC. That's not very enticing when you can play a game as part of your subscription, but it's a great deal when it comes to DLC packs and other add-ons (and it's especially useful when a game you love exits the service). Be aware that those DLC packs are tied to the Microsoft Store version of the game, so they won't necessarily carry over to Steam or other PC platforms.

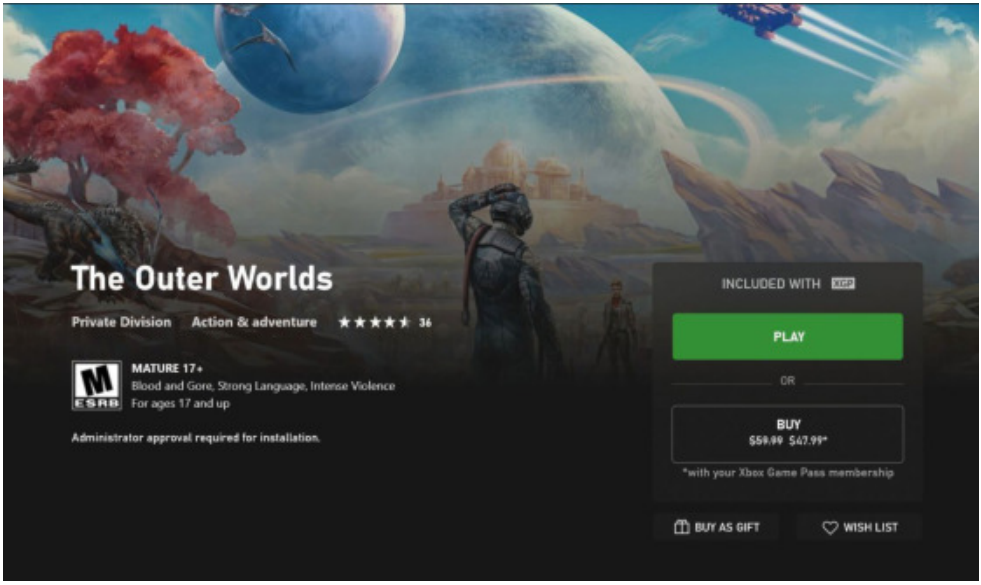
5. GAMES ACTUALLY WORK

Finally, the games install and play without any headaches. This shouldn't be a big plus, but when it comes to Microsoft's PC services, it definitely is.

Games downloaded via Windows 10's Microsoft Store app have been notoriously buggy for years now, running rampant with authentication errors and aborted downloads that require a full reinstall. It's bad enough that I've sworn off buying Microsoft Store Games after blowing through my data cap trying to get *Gears 4* installed. I spent $60 on *Forza Horizon 3* only to spend hours suffering through errors.

Xbox Game Pass for PC skips the Microsoft Store. Instead, you download games via the Xbox app. I've never once encountered an issue installing or playing a Game Pass game. They just work—unlike the Microsoft Store. I don't know *why* the Xbox

Microsoft has added some nice extras to Xbox Game Pass for PC, including games such as *Warframe*.



You'll see Play buttons like this in the Xbox app, unlike the Microsoft Store's endless error messages.

app works so well while the Microsoft Store consistently works so poorly with big games, but I know that it does. If it weren't for Xbox Game Pass for PC, I'd never be able to play *Forza Horizon 4* or *Gears Tactics* (though Microsoft now plans on publishing some first-party games on Steam as well).

BOTTOM LINE: TRY IT OUT

Even if you typically only pay for games you actually own, consider giving Xbox Game Pass for PC a shot. At just $5 a month while the service remains in beta, it's less than the cost of a Big Mac meal. Even after months of subscribing, I've barely scratched the depths of the service. Between Xbox Game Pass for PC, the Epic Game Store's weekly freebies, and perhaps the odd Humble Bundle, you can unlock a virtually endless amount of gaming goodness for the cost of a single new triple-A game. Affordable games are a big part of what makes PC gaming so great compared to consoles, and Xbox Game Pass for PC holds firm in that tradition despite its console namesake.

And no, you don't have to pay for multiplayer.

Give it a shot. Microsoft will even let you try Xbox Game Pass for PC for just $1 for the first month (go.pcworld.com/1d1m). I did after months of hesitance and fell deeply in love. Maybe you will too?

WHEN YOU'RE **BUZZED**, YOU GET IDEAS. LIKE ASKING EVERYONE INSIDE THE TACO TRUCK WHAT **DRIVING** AROUND IN A KITCHEN **IS** LIKE AND THEN ORDERING 22 TACOS WITH EXTRA GUACAMOLE AND ALL THE CHEESE FOR EVERY **DRUNK** PERSON IN LINE. BAD IDEA FOR YOUR WALLET, BUT NOT AS BAD AS **DRIVING** HOME BUZZED.

NHTSA

ad COUNCIL

CAN YOU BELIEVE THAT A NEW HALF-LIFE RELEASED THIS YEAR? I STILL CAN'T.

BY HAYDEN DINGMAN

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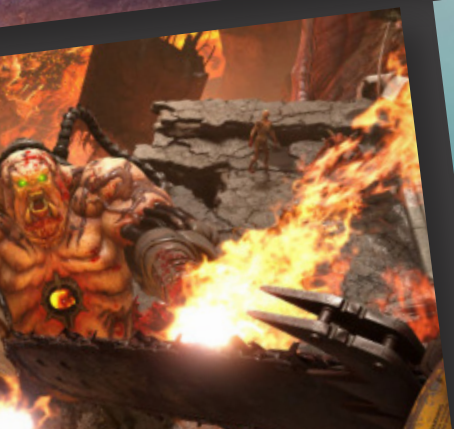
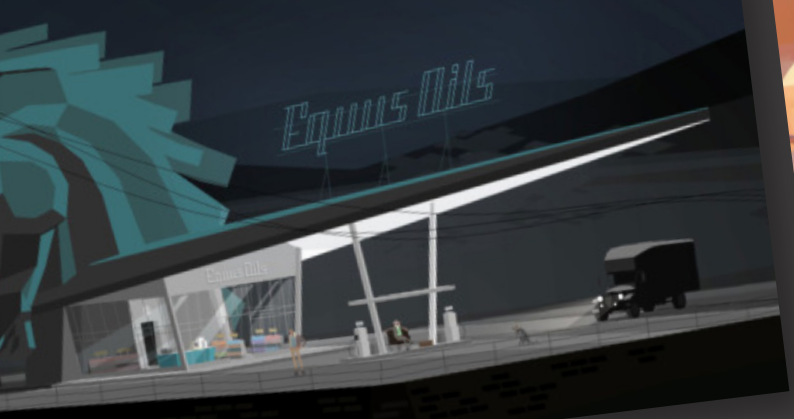




HE BEST PC GAMES OF 2020 (SO FAR)

1.

It's been one hell of a year, eh? Or one hellish year, whichever you'd prefer. This year was already on track to be a weird one for video games, with new consoles just over the horizon. The transition is always awkward, as publishers rush out their last few efforts before the door closes and everyone stops caring about the "old" consoles forever.

But obviously a world in flames has made the release schedule even more volatile than expected. Most of the spring's big games—*Cyberpunk 2077, Vampire: The Masquerade – Bloodlines 2, Wasteland 3, Watch Dogs Legion*—were pushed to the end of 2020, leaving us to celebrate…*Halo 2* (go.pcworld.com/hlo2)?

Halo 2 is a hell of a game.

In all seriousness, there have been some good'uns released in the first half of 2020. Not many. Barely enough to put together a top ten list, actually. But there have been some. Below, you'll find our favorite PC games of 2020 so far, in no particular order.

1. MORTAL KOMBAT 11: AFTERMATH

We don't typically add expansions to our best-of lists, or if we do we reserve them for an honorable mention. But hey, desperate times, right?

Actually, that's selling *Mortal Kombat 11: Aftermath* short (go.pcworld.com/mkaf). Forget the arbitrary restrictions. Aftermath deserves to be on this list, because it's some of the most fun I've had this year (go.pcworld.com/mt11). Picking up right where *Mortal Kombat 11*'s original time-traveling story left off (go.pcworld.com/tmtr), Aftermath reworks the timeline again. The resulting tale of cause and effect, of grand plans and

betrayals, is some of the best storytelling in *Mortal Kombat* to date, and a fantastic capstone on the current trilogy.

The price is steep. Like, *extremely* steep. We don't comment on price often, but $40 to enjoy a two- or three-hour epilogue is a bit hard for even me to swallow. But damn, it's one hell of an epilogue.

2. TALES FROM OFF-PEAK CITY, VOL. 1

A single screenshot convinced me to play through all of Cosmo D's games. In a press release for *Tales from Off-Peak City, Vol. 1* (go.pcworld.com/opct), there was a shot of a city block, and one of the buildings doubled as an enormous face. "That's weird," I thought. "Maybe I should give this a shot."

Little did I know building-shaped-like-a-face was one of the least surreal encounters in Cosmo D's oeuvre. 2015's prologue (or demo) *Off-Peak* (go.pcworld.com/ofpk) is a great place to start if you want to get a feel for these strange adventure games, and *The Norwood Suite* (go.pcworld.com/nrst) is fairly cheap as well. The first takes place in a bootleg train station, the latter in a labyrinthine music-themed hotel. And *Tales from Off-Peak City*? Two city blocks, housing a pizza place, a pawn shop, and (somewhere) a legendary saxophone ripe for the stealing.

Tales from Off-Peak City, Vol. 1 is yet more proof that games can be so much more than just the relentless pursuit of bland realism. Be weird! Be creative! Be uncomfortable! And most of all, be *memorable*.

3. MONSTER TRAIN

Monster Train (go.pcworld.com/mnst) does not put its best foot forward, I think. Most card games—aside from Gwent—relegate story to the back burner. That's fine. But *Monster Train* seemed painfully generic when I first loaded it up, a story of angels versus demons with surprisingly little *soul* to it.

2.

Ignore that, though. Get past the clunky writing and the somewhat awkward interface, and you'll find a fantastic combination of card battler and tower defense. Your

3.

goal is to defend the titular train from invaders, and you do so by doling out your own army each turn. Strong enemies go up front, weak in the back. And because it's just you versus the AI, *Monster Train* allows you to create some truly broken (meaning unbalanced) decks. That's the fun of it really, exploiting card combinations to wreck your enemies. Multiplayer card games always sand those strategies down over time to improve the meta, but in *Monster Train* building an overpowered deck is practically the point.

4. GEARS TACTICS

I'll admit that the longer I played *Gears Tactics* (go.pcworld.com/gtac), the less enamored I felt. The third act is bloated with filler, with meaningless side missions that do little but derail the pacing and pad out the runtime.

And that's a shame because pacing is what sets *Gears Tactics* apart from other tactics games (go.pcworld.com/gtrv), at least in the early hours. When *Gears Tactics* is moving, it really *moves*. Storming into a Locust choke point and blasting away six foes in a single turn, using executions to chain together kill after kill, making a frantic run for the exit as waves of enemies descend on your position—it's a tactics game with the tenor of a shooter. Don't stop. Don't think. Move and act on instinct. That flair for the cinematic is what

4.

elevates *Gears Tactics* above "*XCOM* clone" status, and makes it still worth a look even if the back half grinds.

5. DOOM ETERNAL

Doom Eternal (go.pcworld.com/detr) is one of the most elegant shooters I've ever played (go.pcworld.com/derv). It is meticulously designed, a cascade of systems that push and prod at the player. It is a puzzle you solve at 100 miles per hour, with your hands on fire. Cacodemon? Toss a grenade in its mouth and then rip its eye out. Arachnotron? Shoot off its turret-tail. Mancubus? Destroy its arms. And save the Makyr Drone for your last desperate stand, so you can pop its head off and restock on ammo.

It's not to everyone's liking. I've seen people complain they feel restricted by *Doom Eternal* and the way it designs enemies around a series of hard counters, and those people aren't necessarily wrong. I loved it though, finding in *Doom Eternal* the depth I thought 2016's *Doom* reboot lacked (go.pcworld.com/16rb).

6. ANCIENT ENEMY

Ancient Enemy (go.pcworld.com/anen) is solitaire. "Fancy" solitaire, I've taken to calling it, but solitaire nevertheless. The cards are dealt out, and then you stack them (either one number higher or lower) atop one another until you run out of moves. Draw a card, and repeat.

The twist is that cards in *Ancient Enemy* power up abilities you use to attack various

5.

6.

think." It's easy to go on 20-, 30-, even 40-card runs and annihilate foes in a single turn. And it's solitaire, so you can save the world from an ancient evil while listening to a podcast—or while worrying that the *actual* world is ending, in my case.

enemies, making your way through a world of hooded bandits and skeleton warriors one combo at a time. I suspect the combos are part of *Ancient Enemy*'s appeal, with the game keeping its thumb on the scale in favor of the player. As I said in my review (go.pcworld.com/aerv), "Ancient Enemy gets its hooks in because it feels like you're always outsmarting the game—even though I suspect that's *exactly* what it wants you to

7. DESPERADOS III

A few years ago developer Mimimi Games revived the real-time tactics genre with *Shadow Tactics: Blades of the Shogun* (go.pcworld.com/blsh), drawing on classics like *Commandos* and *Desperados* for inspiration. Apparently they did a good job, because THQ Nordic entrusted them with the actual *Desperados* license for a sequel nearly 15 years in the making.

7.

It paid off. *Desperados III* (go.pcworld.com/dIII) is another fantastic effort from Mimimi. It's every bit the follow-up to Shadow Tactics, but with many of the rougher edges sanded off. More expansive levels and a

well-written and well-acted Wild West story make *Desperados III* maybe the most accessible real-time tactics game ever developed. I'm thrilled *Shadow Tactics* wasn't just a one-off, and I can't wait to see what's next from Mimimi.

8. HALF-LIFE: ALYX

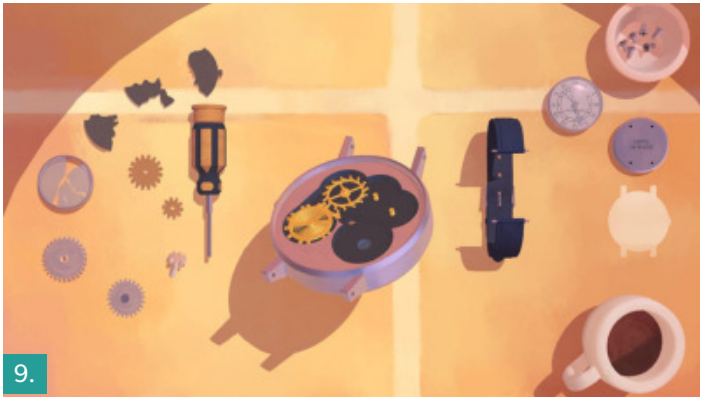
This is the year we finally got a new *Half-Life*, in case you forgot—and it was made for virtual reality. I still can hardly believe it.

What did it mean though? I still don't think we're far enough away to say definitively. Was *Half-Life: Alyx* the watershed moment? Did it convince people to take VR seriously? I don't know. It certainly sold a lot of headsets to a lot of people. Maybe that's enough, even if it didn't break much new ground. Again, *I just don't know*.

I suspect it'll take years for the dust to settle. That said, *Alyx* is an excellent new chapter for *Half-Life* (go.pcworld.com/a1yx), and deserving of a spot on this list even if it didn't reinvent the entire games industry. And hell, maybe now that Valve's broken free from the weight of expectations, it won't feel so hemmed in developing the next chapter.

9. ASSEMBLE WITH CARE

Earlier this year I spent a lot of time watching *Repair Shop*, a delightful show where British artisans fix various objects. Part of my fascination was the mechanical, watching Steve Fletcher disassemble and clean old clocks. But the best episodes had little to do with the *how* of the repair and more to do

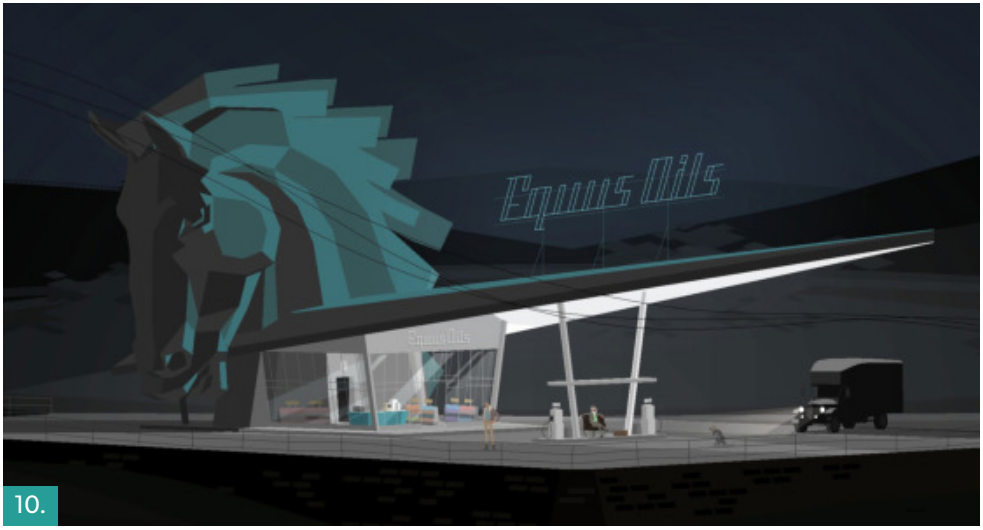

9.

with the *why*. Maybe someone brought in an old toy from their childhood, or a sign that hung outside their neighborhood pub for decades, or their grandmother's rocking chair. Seeing the owner's face when the object was unveiled, good-as-new, *that* is the real draw of *Repair Shop*.

Anyway, *Assemble with Care* (go.pcworld.com/ascr) taps into that same feeling. It's a short game about repairing various household items, yes, but really it's a game about the *memories* with which we imbue said items. In an era where most objects are mass-produced and disposable, the memories are what warrant the time and labor and love that goes into repair.

10. KENTUCKY ROUTE ZERO

Kentucky Route Zero (go.pcworld.com/knrz) is the game of the generation, if only because



10.

it took the entire console generation to release. Episodic back when episodic was in-fashion, the first chapter released back in 2013, the last this past January. Or to put it in slightly more personal terms: The first chapter released right before I arrived at *PCWorld,* and…well, I've been here quite a while.

And I naively put off playing it for years, waiting to experience it in one go. Then I did and *wow*. As I said in my review (go.pcworld.com/knrv), it's obvious in retrospect that so many of the games I loved this generation drew from *Kentucky Route Zero*, in spirit if not directly. That list includes *Disco Elysium, Celeste, Night in the Woods*, even (probably) *Tales from Off-Peak City*.

Kentucky Route Zero is the kind of game that makes other people want to make games. A sprawling story of love and found family and betrayal and loss and Capitalism, it's messy and unapologetic and very heartfelt. I saw myself in its characters. I saw my friends in its characters. It's one of the finest pieces of interactive fiction I've ever played—and only "one of" because so many developers have taken its lessons and run with them these past seven years.

HONORABLE MENTION
11. TOWNSCAPER

Plop. Plop. Plop. There is no conflict in *Townscaper* (go.pcworld.com/twsc), nor goal. It's a game about building for the sake of building, a freeform architectural tool with only two controls. Left Click, you add. Right Click, you subtract.

Click once, you've made an island. Click again, a small cottage. A few more times, a village. And while "Seaside Village" is the easiest and most obvious product of Townscaper's tools, I've seen some incredible creations since its release a few weeks ago. Castles and labyrinths, modernist hotels and fantastical towers, it's the perfect game to unwind with at the end of the night (go.pcworld.com/twrv). Start clicking and see where it takes you. I'm excited to see where *Townscaper* goes as Early Access progresses, but it's already one of my favorites for 2020.

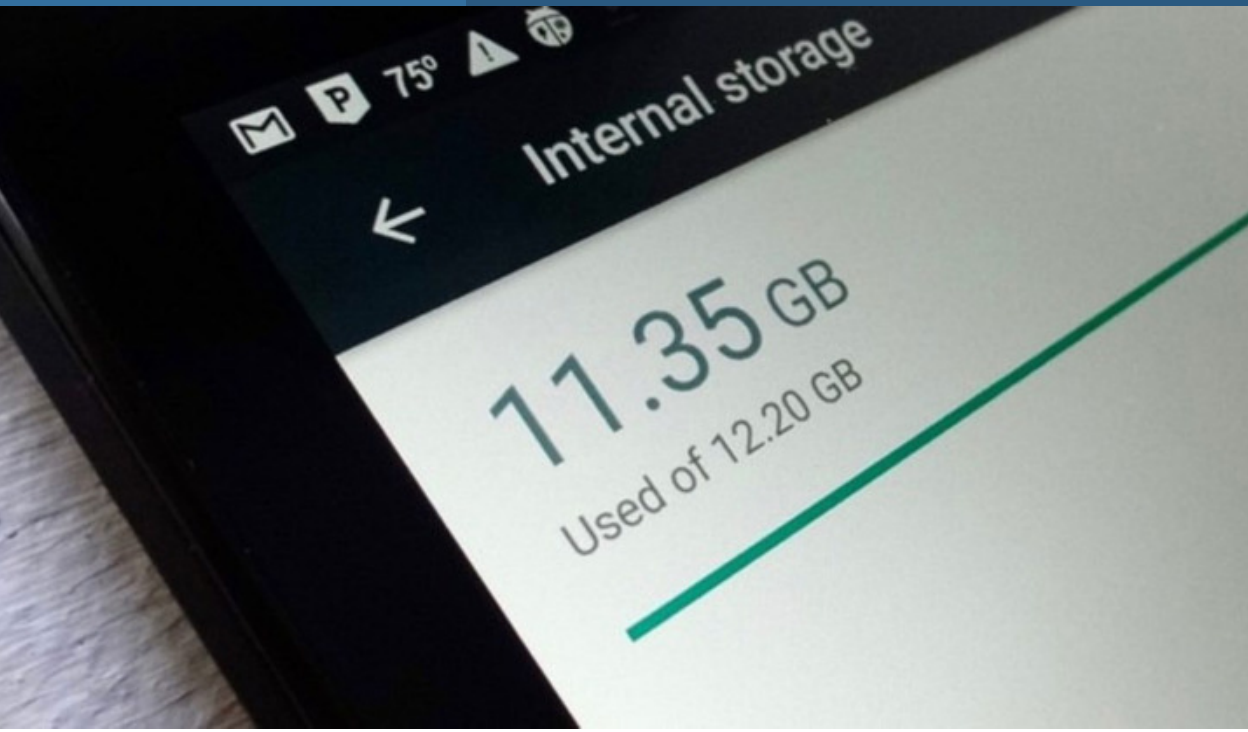
11.

STAYING HOME SAVES LIVES.

CORONAVIRUS.GOV

ARTWORK BY THOMAS WIMBERLY / AMPLIFIER.ORG

ad COUNCIL



11 quick ways to clear space on an overstuffed Android phone

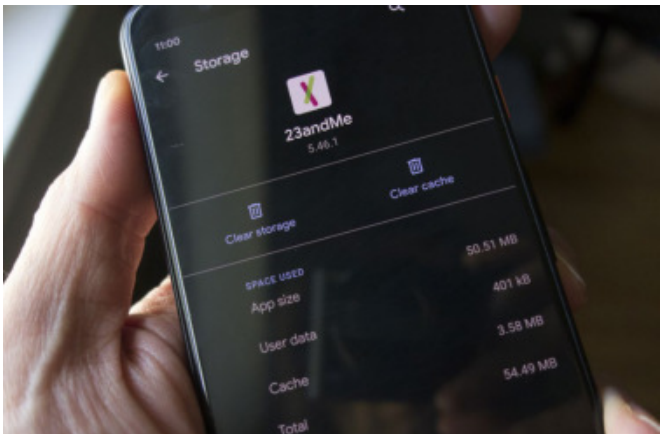
Zap cached app files in a single tap, clear the Downloads folder, delete unneeded offline maps, and more. **BY BEN PATTERSON & MICHAEL SIMON**

Few things in life are as annoying as finding that your Android handset refuses to install any more app updates because it's run out of storage. Unlike many of life's little annoyances, though, this one's easy to fix. You can't do anything about your system files, but you can quickly clear out precious gigs by sweeping up stale downloads, rooting out offline maps and documents, clearing caches, and wiping unneeded music and video files. And if these tips don't do the trick, check out our picks for the best Android phones for every need and budget (go.pcworld.com/anph).

1. CLEAR OUT ALL CACHED APP DATA

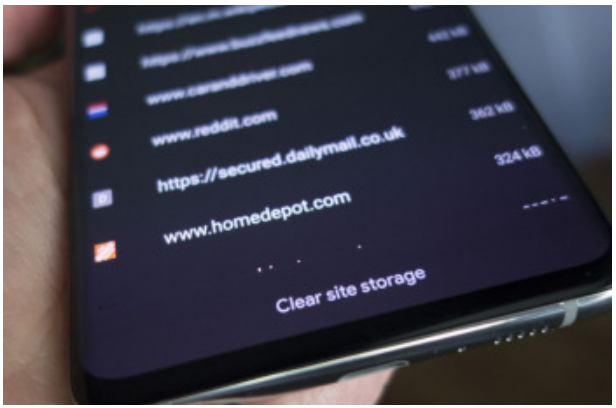
If you dig into the Apps storage setting screen and tap on an individual app, you'll notice that each app has its own stash of "cached"

IMAGE: BEN PATTERSON



Clearing out cache won't save a ton of space at once but it will add up.

data—anywhere from a few kilobytes to hundreds of megs, or even more. These caches of data are essentially just junk files, and they can be safely deleted to free up storage space. Select the app you want, then the Storage tab, and then the Clear Cache button to take out the trash.



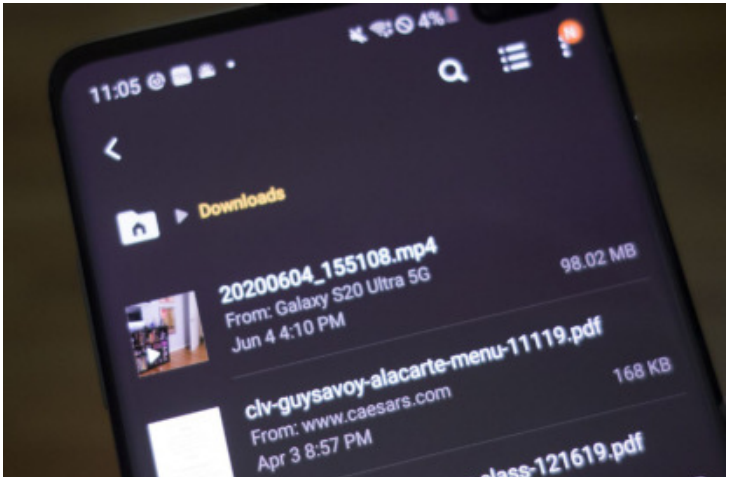
Chrome can use up a bit of your phone's space.

2. TAME YOUR CHROME BROWSER

One of the biggest background abusers of your phone's space is a web browser. Each time you visit a site, it stores a little bit for faster loading, and they can add up over time. To bring things back down to size, open Chrome on your Android phone, tap the menu in the top right corner, and open Settings. Then go to Site Settings and scroll down to Storage. At the bottom of the screen, you'll see a Clear site storage option. Tap it and you might free up a couple of hundred megabytes.

3. CLEAN UP YOUR DOWNLOADS

Just like on a PC or a Mac, your Android device has a Downloads folder. You'll find it inside the Files app on most phones—though it's called My Files on Galaxy phones—and it's a favorite hideout for miscellaneous junk files downloaded from the web or some other app. When you find it, tap the three-line menu icon in the top corner of the screen and sort the list of downloads by



Your phone saves everything you've ever downloaded so you might need to clear it every once in a while.

Note: If you're using the High Quality setting for unlimited but lower-resolution cloud storage of your backed up photos, keep in mind that the Free Up Device Storage feature will delete your full-resolution originals. Make sure you've stored them elsewhere before you tap the OK button.

size, then take a look at what's hogging the most storage space. Then simply tap and hold to select the ones you don't want and trash them.

4. DUMP PHOTOS THAT ARE ALREADY BACKED UP

One of the best features of Google's Photos app is its ability to back up your entire photo library to your online Google account. Once your snapshots are safely backed up, Photos can zap any locally stored images to free up more space. Open the Photos app, tap the three-line menu button in the top left corner of the screen, then tap Free Up Space. The Photos app will let you know how many pictures it can delete from local storage and how much space you'll save. Tap OK to pull the trigger.

5. MANAGE DOWNLOADED MUSIC, MOVIES, AND PODCASTS

The biggest space suckers on your Android phone are media files. Those albums that you downloaded for a camping trip or a movie for a long plane ride that you simply forgot about can eat up lots of data. Thankfully they're easy to find and remove. First, head over to the Storage tab in Settings and check the Audio and Video folders to see if there are any files that can be deleted.

You'll also want to check your individual streaming apps for any downloaded files. That includes Spotify, Netflix, YouTube Music or any other app you use since files may be contained within the app itself.

6. ERASE OFFLINE AREAS IN GOOGLE MAPS

Downloading a map in the latest version of the Google Maps app is a great way to navigate when your device is offline, especially now that both searching and driving directions are supported.

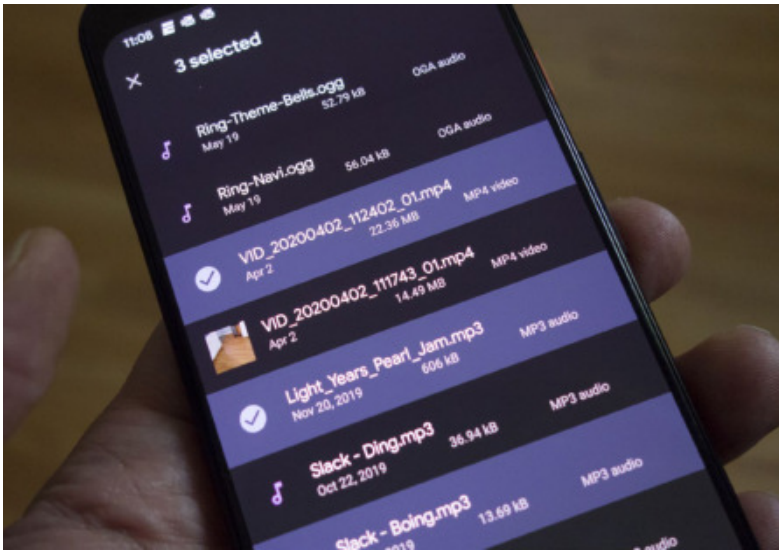
But those searchable offline "areas" come at a cost: storage space, and potentially lots of it. Indeed, a single offline map can consume more than a gigabyte of storage depending on the size of the area.

You can check how much space your offline maps have staked out by tapping the three-line menu button in the top left corner of the main Google Maps interface, then tapping Offline. The storage used by each offline map is displayed below its name. Tap the map and tap Delete to reclaim its storage space.

7. UNLOAD YOUR LEAST-USED APPS

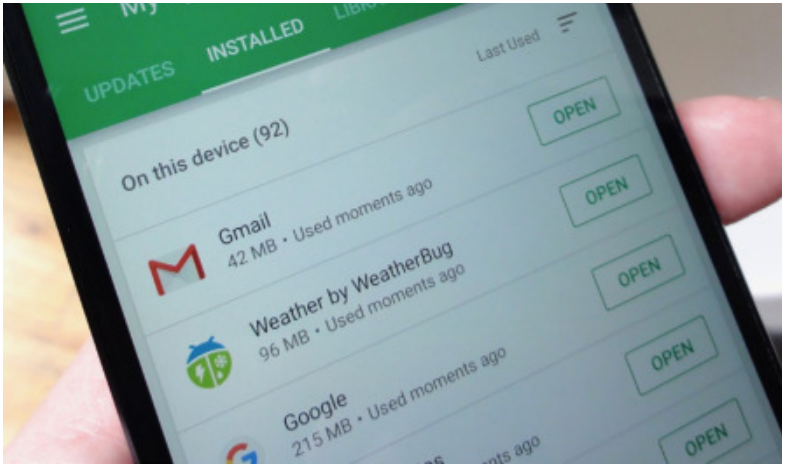
I love the fact that I can download and install Android apps to my devices remotely from a desktop web browser. The downside? My Android handsets tend to be overstuffed with too many apps, many of them used only once (or even never).

The solution, of course, is to delete some of those apps—ideally, the ones you use the least. There are also several apps that can track your app usage and tell you which apps you're using the least, among them: App Usage (go.pcworld.com/ausg) and QualityTime (go.pcworld.com/qltm). But the best judge of the apps you don't want is you. You can either browse your app drawer to find any apps you don't need anymore, or check out your library in the Play Store.



Audio and video files can be huge space suckers.

To find a list of everything on



You can find out which apps you use the least with help from the Play Store app.

your phone, open the Play Store app, tap the three-line menu button in the top right corner of the screen, tap My Apps & Games, then tap the Installed tab. From there, tap the Manage Your Apps tab. On the next page, you'll see a list of your apps sorted by how often you use them and you can easily delete the ones you don't need anymore.

8. USE YOUR PHONE'S STORAGE TOOLS

If you're lucky enough to have a phone that's been updated to Oreo, Google has built in some great tools for tracking and managing your storage limits. Head over to the Setting app and tap the Storage tab. Inside you'll find a handy rundown of everything that's taking up space on your phone, just like on Nougat. But in Oreo, you have more control over your files. Tap on any of the sections and you'll see a list of related apps and how much space they're using. Tap again, and you'll be able to clear anything inside by selecting the Free Storage button. Just keep in mind that this will clear any files being held inside the app.

The storage manager in Android Oreo will help you see exactly what's eating your phone's free space.

You'll also find a new Free Up Space button at the top of Oreo's storage manager. Tap it and you'll see a list of your downloads and infrequently used apps, as well as an option to clear any photos and videos that have already been backed up to the cloud. It's essentially a shortcut, but it's a handy one.

9. TURN ON SMART STORAGE

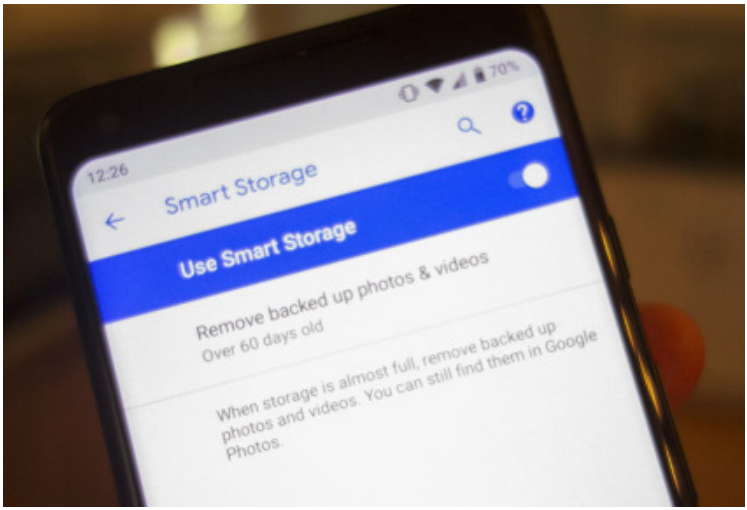
Oreo includes a new toggle called Smart Storage that can work wonders without needing to do a thing. Flip it on, and your phone will automatically clear out the biggest space-stealing culprits: photos and videos.

Since we all forget to clear out our photo libraries regularly, you can choose to automatically remove backed-up photos and videos after 30, 60, or 90 days, making sure your phone isn't stuffed with duplicate photos.

10. GET AN SD CARD

Nearly every Android phone you can buy in 2018 has a slot for expandable storage, so you'll be able to double, triple, and quadruple the space on your phone for just a few bucks. You'll want to get a micro SD Card from Samsung or SanDisk in at least 32GB capacity. Prices per gigabyte decrease substantially as the capacity increases, so you should buy the biggest card that you can afford. As a very general rule, around $0.40 per gigabyte is a good price.

Once you select the size you want, installing it is a snap. There's no formatting to worry about, just pop open your SIM card slot and slide in the SD Card. Then, you'll be able to shift files and apps onto the card as needed to free up precious internal space. Most phones support SD Cards, thought Google's Pixel phones and certain Galaxy phones do not.


12:26
70%
Smart Storage
Use Smart Storage
Remove backed up photos & videos
Over 60 days old
When storage is almost full, remove backed up photos and videos. You can still find them in Google Photos

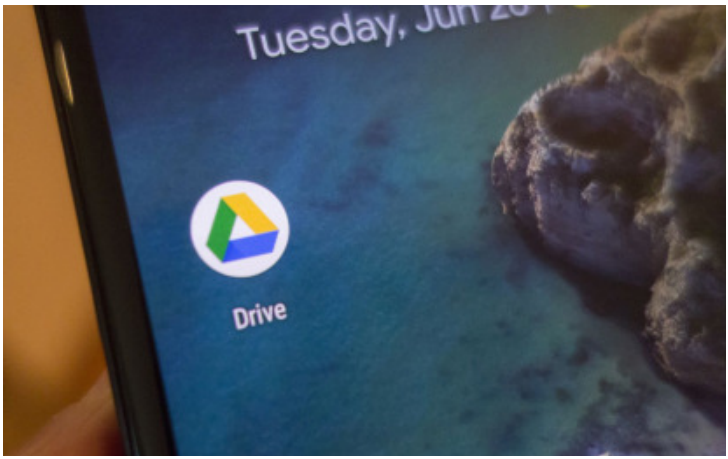
Android Oreo's Smart Storage can free up space without your needing to lift a finger.

The best way to free up space on your Android phone is to add more of it.

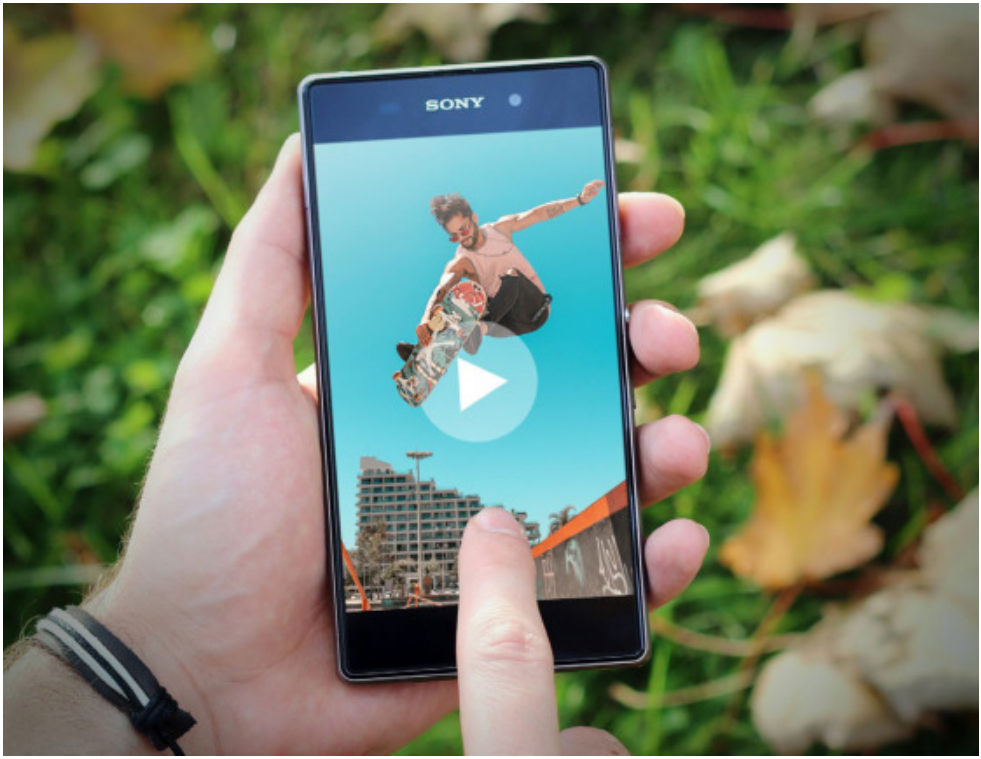
11. TAKE ADVANTAGE OF GOOGLE DRIVE

Google gives 15 gigs of free cloud storage with every account, so you might as well use it. Anything inside your Downloads or Files app can be jettisoned to your Google Drive by tapping the menu button in the top right corner and choosing Send To. This will open the share sheet, where you can select Save To Drive to choose which folder to add it to. Then you can delete it from your phone without losing it forever.

And if 15 gigs aren't enough, you can upgrade to Google One and increase your storage by an order of magnitude for just a few bucks a month. For just $1.99 per month, you'll get an extra 100GB of space, and a buck more ($2.99/month) will double it to 200GB.



Your phone comes with 15GB of free space that you might not be utilizing.



Share large video files on Android

Don't send a video directly through text message or a chat app—instead, share a link to a cloud-stored version. **BY ALAINA YEE**

Videos can be trickier than photos to share with friends and family. If you've captured more than a few seconds of content, the original file ends up too big to send directly through text message or a chat app like WhatsApp or Hangouts. You can't upload and send it as-is.

Fortunately, the default photo gallery app on your phone should have built-in features that circumvent this problem. You just select the video you want to share, generate a link, and then send that URL to your recipient. The app takes care of uploading the file to the cloud and all the other back-end work.

IMAGE: JESHOOTS / PIXABAY (CC0)

HOW TO SHARE VIDEO ON ANDROID

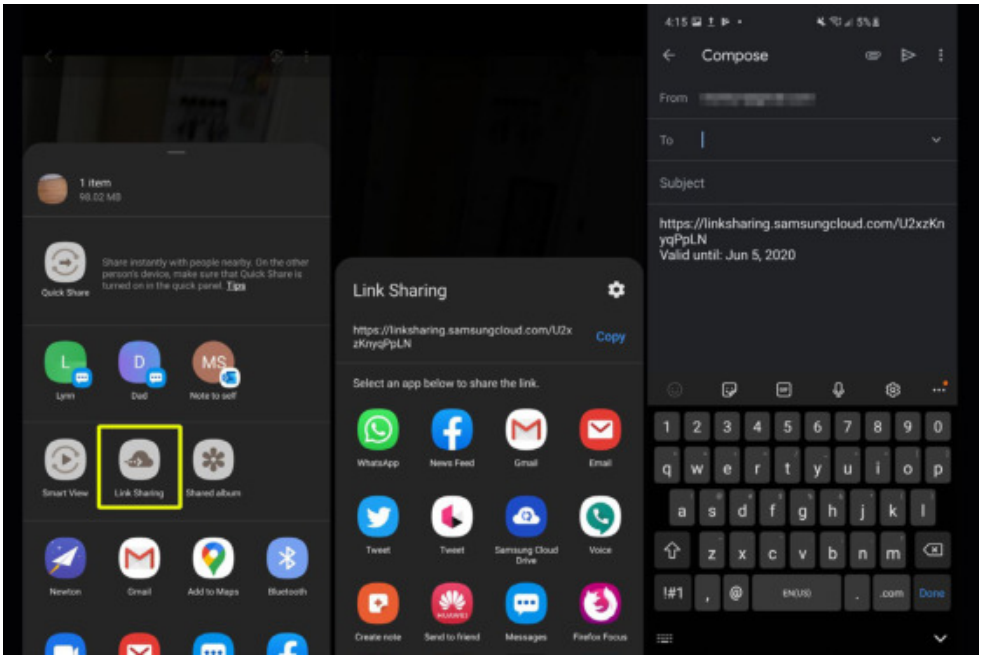
1. Open your phone's photo gallery app. Samsung users should look for Gallery and stock Android users should look for Photos (aka Google Photos). Other phone manufacturers will follow similar naming.

2. Find the video you want to share. The simplest way to do this is to scroll through your mix of photos and videos. Some apps also let you do a search for the word *video*, which will filter and show only that specific file type.

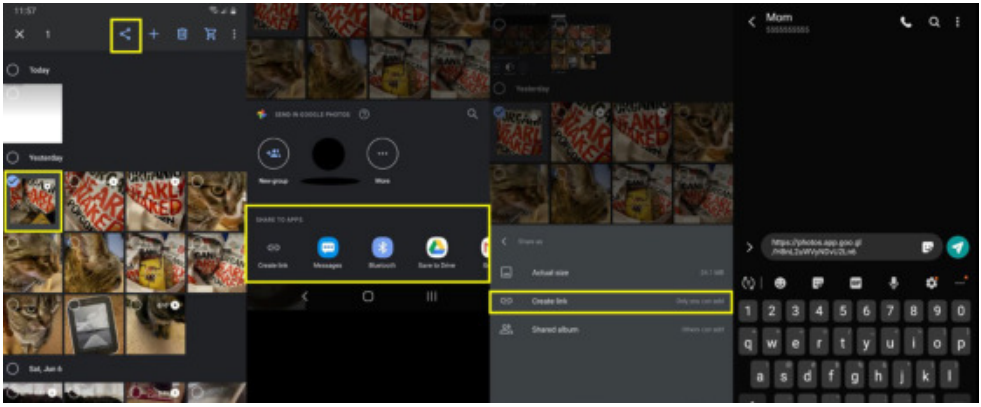
3. Long-press on that video. In some apps, a text menu will pop up; choose Share. In other apps, you'll need to find the Share icon and tap on it. (It looks like the letter "V" with dots, rotated clockwise to the right.)

4. You can choose to share a link directly to an app, or to copy the link. The former saves a little time if you have only one recipient, while the latter is more helpful if you want to paste the URL in several chat windows and/or apps.

5. If you choose to share directly to an app, select the app from the options shown in



These screenshots show the process for sharing a video through the default photo gallery app on a Samsung Galaxy phone.



These screenshots show the process for sharing a video through the default photo gallery app through Google's Photos app.

the menu—typically it will be a chat or email app.

6. If you create a link, it'll get copied to your phone's clipboard, and now you can manually navigate to the app(s) you want to paste it into. Fire away!

Having trouble getting these steps to work in your phone's default gallery app? Google Photos is available to everyone to download in the Google Play Store—so you can use this app specifically for sharing video files.

(Note: Sharing videos through Google Photos can eat into your storage allotment for your Google account depending on your settings. Free accounts have 15GB of space shared across all services, which includes Gmail, Drive, and Photos; you can work around this limitation by changing Google Photo's backup settings to High Quality, which offers unlimited storage but caps video resolution at 1080p [go.pcworld.com/capr].)

ALTERNATIVE (SECURE) METHOD

As mentioned above, sharing videos in this fashion relies on cloud storage. Samsung's gallery app uses temporary storage (go.pcworld.com/tmst), while Google Photos requires that you still have free space attached to your account. In both cases, the file gets put on to a server, and then the app provides a shareable link.

However, by default, these links are viewable to everybody—so if your video gets passed on to others without your knowledge, they can watch, too. You can preserve your privacy by instead uploading your files to a cloud storage service (like Google Drive, Dropbox, or OneDrive) and emailing a link

that restricts viewing to that specific audience.

The instructions vary a bit in each service's app, but you'll follow these general steps:

1. Download your chosen service's app through the Google Play Store app.

2. Sign up for or sign in to the service.

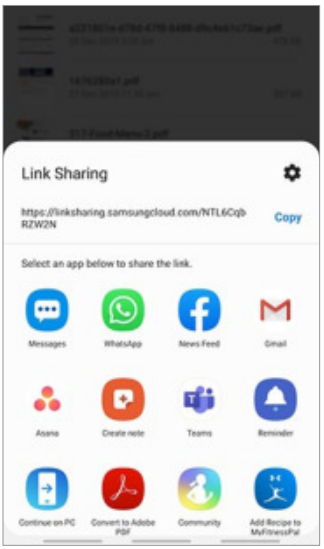
3. Upload your video. (Usually, you'll tap a plus-sign icon, then choose from your recent files.)

4. Share this new copy of your video. You'll typically do this by long-pressing on it and pressing the Share icon, or tapping a vertical three-dot icon next to the file and choosing Share.

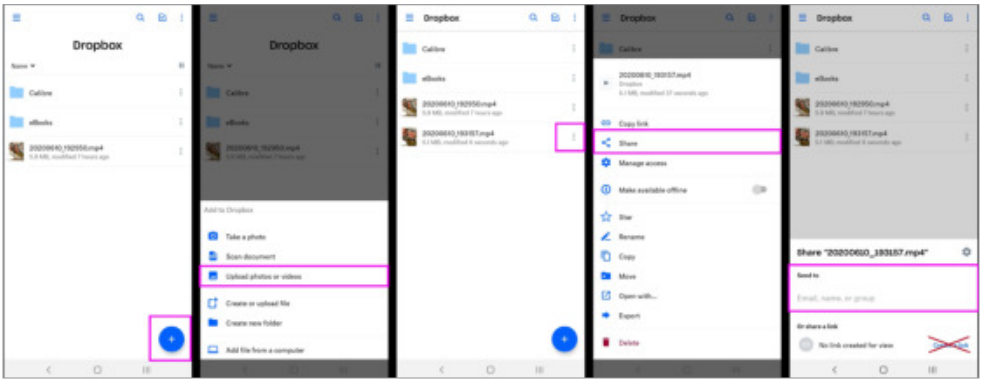
5. Choose Invite People or Send To—while creating a link also exists as an option, that works the same as sharing through Samsung's Gallery app or Google Photos and does not restrict access.

6. Fill in the email addresses of the people you wish to send the link to. In some apps, you may also need to change the permission level from Edit to View, and/or enable a sign-in requirement to get access to the file.

7. Send the invites.



Samsung's Link Sharing lets you upload large files from a Galaxy device to Samsung Cloud and then send links to others.



An example of the more secure sharing process, as seen in Dropbox. The process is generally similar in Google Drive, OneDrive, etc., but the details and layout of the app might be a little different.

Word reads to you: How to use the Speak and Read Aloud commands

The Speak feature was incorporated into Office back in version 2003. **BY JD SARTAIN**

Can Microsoft Word read to me? Yes, it can. There are three ways to accomplish this task: The Speak and Read Aloud features in Word, or the Narrator feature in Windows.

The Speak feature was incorporated into Microsoft Office (Word, Outlook, PowerPoint, etc.) back in version 2003. It was called Text To Speech (TTS) then, and it functioned much the same as it does now. Fortunately, it's a very simple procedure to set up and use, so you can get started immediately.

ADD THE SPEAK BUTTON TO THE QUICK ACCESS TOOLBAR

1. Click the Customize arrow on the Quick Access Toolbar.

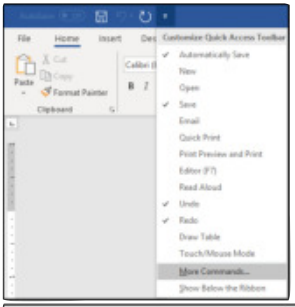
2. From the drop-down menu, select More Commands.

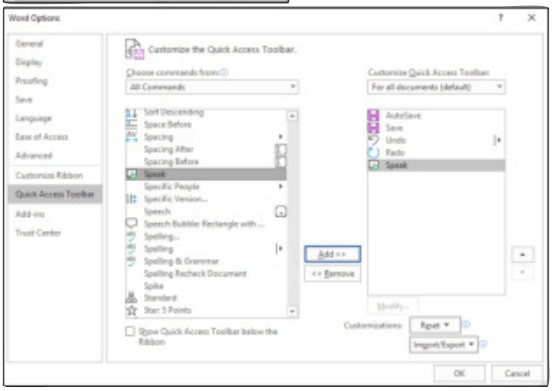
IMAGE: ROB SCHULTZ

3. Go to Word Options > Customize The Quick Access Toolbar and locate the Choose Commands From box. Scroll down to the Speak command.

4. Select the Speak command, click the Add button in the middle of the screen, then click OK.

5. Word adds the Speak command to the Quick Access Toolbar at the end, and you're ready to go.





Add the Speak button to the Quick Access Toolbar.

CLICK THE SPEAK BUTTON TO LISTEN TO YOUR TEXT

1. Ensure that your system's speakers or sound devices are turned on.

2. Highlight a paragraph of text, then click the Speak command button.

3. Word reads any text that's highlighted, even the entire document. Press **Ctrl+ A** to select the entire document.

4. Click the Speak command button once to begin the reading session, then click it again to stop. There is no pause-and-continue option at this time, but many users have requested this feature, so we hope to see it in future versions.

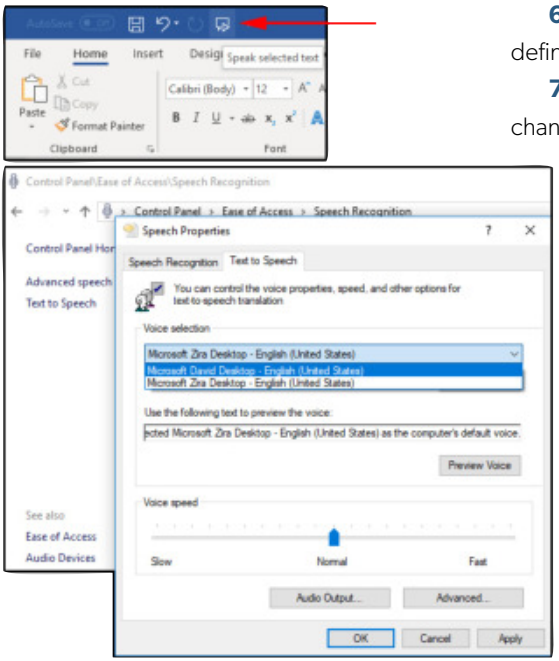
SELECT THE READ ALOUD COMMAND

Another way to have your text read aloud in Word is to select the Review tab and then the Read Aloud button.

The greatest benefits of Read Aloud as opposed to the Speak command is that (a), you don't have to highlight the text. Just position your cursor where you want the reading aloud to begin and click the Read Aloud button. And (b), when you click the Read Aloud button a second time, it stops. Click the button again to continue from that point on. So, essentially, you have a Pause feature with Read Aloud that is not available with Speak.

CHANGE THE SPEAK PREFERENCES IN THE WINDOWS CONTROL PANEL

The Speak preferences are defined in



How to change the *Speak Selected Text* preferences.

Windows, not in Word specifically.

1. Click Start > Windows System > Control Panel.

2. Select Ease of Access > Speech Recognition > Text To Speech, and the Speech Properties dialog window opens on the Text To Speech tab.

3. Under Voice Selection, choose MS David Desktop for a male voice or MS Zira Desktop for a female voice.

4. Click the Preview button to listen to each voice, then make your selection.

5. Use the slider under Voice Speed to adjust the pace (slow, normal, or fast) of the reader.

6. Click the Audio Output button to define the Sound preferences.

7. Click the Advanced button to select or change the output device.

USING WINDOWS 10 NARRATOR IN WORD AND BEYOND

Windows 10 Narrator is an accessibility feature designed for vision-impaired users, however, anyone can use it. It reads everything onscreen: documents, websites, comments, page instructions, commands, and more. It's also not restricted to Word, as the Speak feature is.

Using Narrator is really easy, though learning all the commands may take some time. See Microsoft's "Complete guide to Windows Narrator" (go.pcworld.com/nrgd) for full information. (If you search elsewhere online for WIndows 10 Narrator help, check the date of the article and the Windows version before you start memorizing commands.)

There are two keyboard layouts available: Standard and Legacy. The default is Standard. Follow these instructions to change the keyboard (which changes how the commands function). For more information, go to Microsoft's support page about Narrator keyboard layouts (go.pcworld.com/nrly).

1. Right-click the Windows Start button and select Settings.

2. Select Ease of Access.

3. Click Narrator in the left panel.

4. Browse to Choose Keyboard Setting.

5. From the Select Keyboard Layout field box, choose Standard or Legacy.

6. Next, select your Narrator Modifier key (that is the key used to activate the Narrator commands). Options include Caps Lock, Insert, or Caps Lock and Insert. I chose the Caps Lock key, because its location on the keyboard is more efficient.

7. Once you have chosen the Narrator Modifier key, the instructions here and on the web will refer to that key as the Narrator key (or, in some cases, the SR key).

8. Exit the Settings menu.

The basics for using Narrator are this:

1. Press **Windows logo key + Ctrl + Enter** (simultaneously) to access or exit Narrator.

2. If you have not memorized all the "reader" keystrokes yet, the easiest method to read text is to place your cursor on the target word/sentence/paragraph and press **Narrator key + Down Arrow**. Press **Narrator key** (by itself) to stop, then **Narrator key + Down Arrow** to continue. There are other keys that perform this same function, but these are the easiest.

3. Most important: For a list of all the Narrator commands, press **Narrator + F1**.

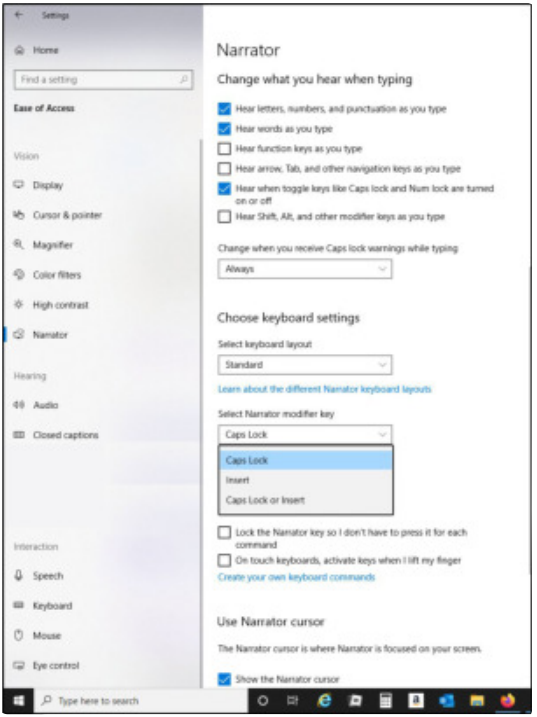
4. For reading the current paragraph, press **Narrator + Ctrl + K**.

5. For the next paragraph, press **Narrator + Ctrl + L**.

6. For the current page, press **Narrator + Ctrl + I**.

7. For the next page, press **Narrator + Ctrl + O**.

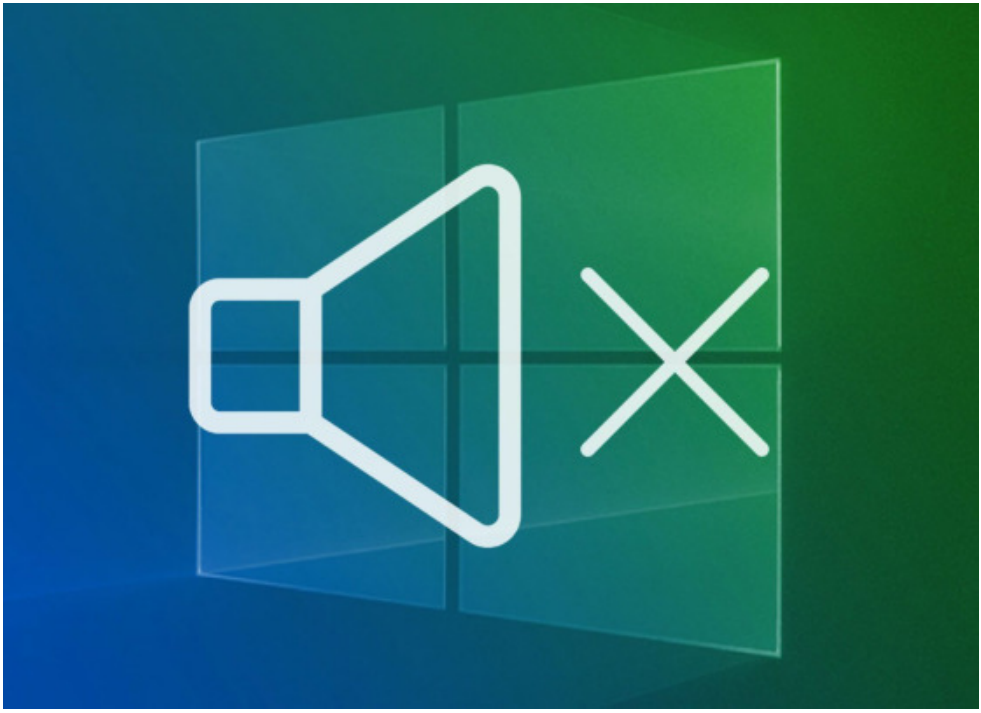
The list goes on and on. In addition to the complete guide above, check out the support pages for Windows 10 Narrator keyboard commands and touch gestures (go.pcworld.com/nrky), and Windows 10 narrator reading text (go.pcworld.com/nrrd).


Settings
Home
Find a setting
Ease of Access
Vision
Display
Cursor & pointer
Magnifier
Color filters
High contrast
Narrator
Hearing
Audio
Closed captions
Interaction
Speech
Keyboard
Mouse
Eye control
Narrator
Change what you hear when typing
Hear letters, numbers, and punctuation as you type
Hear words as you type
Hear function keys as you type
Hear arrow, Tab, and other navigation keys as you type
Hear when toggle keys like Caps lock and Num lock are turned on or off
Hear Shift, Alt, and other modifier keys as you type
Change when you receive Caps lock warnings while typing
Always
Choose keyboard settings
Select keyboard layout
Standard
Learn about the different Narrator keyboard layouts
Select Narrator modifier key
Caps Lock
Caps Lock
Insert
Caps Lock or Insert
Lock the Narrator key so I don't have to press it for each command
On touch keyboards, activate keys when I lift my finger
Create your own keyboard commands
Use Narrator cursor
The Narrator cursor is where Narrator is focused on your screen.
Show the Narrator cursor
Type here to search

Windows Narrator keyboard settings.

How to fix audio problems on your Windows PC

You can usually resolve the issue quickly. **BY ALAINA YEE & CHRISTOPHER NULL**



For all its positives, Windows sometimes acts in unexpected ways—like a sudden lack of audio. If your PC abruptly stops playing sound, try these easy steps to fix the issue:

NO SOUND IN ONE APP

1. First, reboot your computer.

2. Confirm the program's volume isn't turned down or muted. In browsers like Chrome and Firefox, each tab can be muted individually—right-click a tab to see its status. (The option will say Unmute Tab if a tab is currently silenced.)

3. If you still can't hear anything in this program, try uninstalling and reinstalling it.

IMAGE: ROB SCHULTZ

Before doing so, first back up any data and/or write down how your settings are currently configured, as applicable.

Note: For paid software, your license for the program may be tied to a specific version—if that's the case, you may need to do a little hunting to find its installation program on the vendor's website. This same advice applies if you just prefer your version of the app over the current one.

NO SOUND AT ALL

1. First, check to make sure Windows is using the correct device for speaker output by clicking on the speaker icon in the taskbar. (Sometimes Windows 10 will switch output to a different device, unbeknownst to you.) At the top of the pop-up window, you'll see the name of the speaker currently in use—e.g., Speakers (2-Anker PowerConf). Click on that name to switch to the proper device, if applicable. If using external speakers, make sure they are powered on.

2. Reboot your computer.

3. Verify via the speaker icon in the taskbar that the audio is not muted and is turned up.

4. Ensure that the computer isn't muted via hardware, such as a dedicated mute button on your laptop or keyboard. Test by playing a song.

5. Right-click the volume icon and click Open Volume Mixer. Ensure that all options are on and turned up.

6. Internal speakers still not working on your laptop? Plug headphones into the audio jack and test again. If the headphones work, remove them to continue troubleshooting the internal speakers.

7. For desktop systems with speakers plugged into the 3.5mm jack, try a USB speaker or USB headphones. (Or vice versa.) If the alternative device works, remove it to continue troubleshooting the initial set of speakers. (See our roundup of best budget computer speakers [go.pcworld.com/bdsp] if you are in need of a new set.)

8. Right-click the volume icon again and choose the Open Sound settings. In the window that opens, find Related Settings, then click on Sound Control Panel. In the Playback tab, confirm that your audio device (likely Speakers) has a green checkmark next to it. Then click Properties and make sure that Use This Device (Enable) is selected.

If your sound still doesn't work by this point, you may have a missing or corrupt driver for your audio controller.

1. Uninstall the driver. Open the Device Manager (type **`device manager`** in the taskbar search box), go to Sound, Video And Game Controllers, select the audio controller for the device that's malfunctioning, and press the **Delete** key.

2. Reboot the system and allow Windows to reinstall the driver, which it should do automatically. If it doesn't, download the driver from your PC maker's site or audio card manufacturer's site, and reinstall it manually.

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